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CONTENTS

Foreword ... iii
Chairman's report ... 1

Geoscience organization charts ... 4
  British Columbia ... 4
  Alberta ... 5
  Saskatchewan ... 6
  Manitoba ... 8
  Ontario ... 9
  Quebec ... 10
  New Brunswick ... 11
  Nova Scotia ... 12
  Newfoundland ... 13
  Northwest Territories ... 14
  Yukon ... 15

Provincial Geological Survey Expenditures, 1988-1989 ... 18
  British Columbia ... 19
  Alberta ... 20
  Saskatchewan ... 21
  Manitoba ... 22
  Ontario ... 23
  Quebec ... 24
  New Brunswick ... 25
  Nova Scotia ... 26
  Newfoundland ... 27
  Northwest Territories ... 28
  Yukon ... 29

Geological Program Highlights ... 31
  British Columbia ... 32
  Alberta ... 36
  Saskatchewan ... 38
  Manitoba ... 45
  Ontario ... 50
  Quebec ... 56
  New Brunswick ... 66
  Nova Scotia ... 71
  Newfoundland ... 76
  Northwest Territories ... 79
  Yukon ... 84

Geological Publications ... 87

Articles ... 89
  Survey of federal-provincial mineral development agreements ... 91
  Survey of hard rock drill core programs in Canada, fiscal year 1988-1989 ... 93
  Annual review of activities, provincial and federal geoscientific organizations ... 94
  Discovery methods for Canadian metal mines that opened in 1988 ... 95
  Open letter to the Committee of Provincial Geologists ... 97
  Geoscience information systems in Canadian geological surveys ... 105
  Geoscience map symbols used by federal, provincial and territorial geoscience organizations ... 109

Membership of the Committee of Provincial Geologists ... back cover

1989
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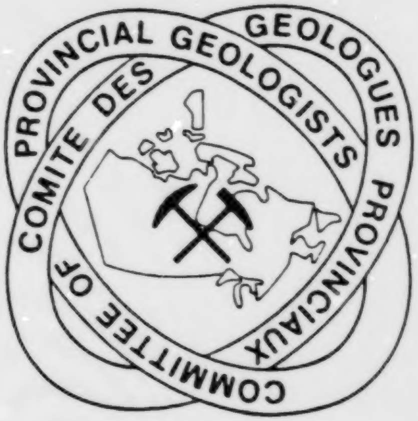
JOURNAL DES GÉOLOGUES PROVINCIAUX



VOLUME 7

PUBLICATION ANNEULLE DU

COMITÉ DES GÉOLOGUES PROVINCIAUX

PUBLISHED ANNUALLY BY

COMMITTEE OF PROVINCIAL GEOLOGISTS

91-02817/

FOREWORD

We are pleased to present Volume 7 of the Provincial Geologists Journal. When we accepted to edit and publish Volume 7, we did so because all of us recognized the importance the Journal has for our individual organizations and industries and the need to perpetuate the Journal was self-evident.

I would like to thank all the people and institutions that compiled submissions for this volume. They include Ron Smith and Mike Fournier, Ministry of Energy, Mines and Petroleum Resources, British Columbia; Dave McRitchie, Energy and Mines, Manitoba; Vic Milne, Mike Grant and Guy Kendricks, Ministry of Northern Development and Mines, Ontario; Jean-Louis Caty and Denis Lefebre, Ministere de l'Energie et des Ressources, Quebec; and Peter Giles, Department of Energy and Mines, Nova Scotia.

The Alberta Research Council was responsible for editing and final compilation. Thanks to Mike Prentice and his team Doug Boisvert, Karen Parrish-Hite, Dale Hite and Marg Booth for the production of this volume.

The Provincial Geologists Journal is available in each province and territory through the offices of the geological surveys or relevant information centres or distribution offices of mineral resources departments of provincial and territorial governments.

Jan Boon
Head,
Alberta Geological Survey
Alberta Research Council

THE COMMITTEE OF PROVINCIAL GEOLOGISTS
CHAIRMAN'S REPORT 1989

The Committee of Provincial Geologists met twice in 1989; at the annual convention of the Prospectors and Developers Association of Canada in Toronto in March, and in August, during the Mines Ministers Conference in Sudbury.

Major activities of the Committee during the past year include publication of the Provincial Geologists Journal, organization of the Provincial Activities Session at the PDAC, and initiation, through the National Geological Surveys Committee, of procedures to coordinate development and implementation of Geoscience Information Systems.

Volume six of the Provincial Geologists Journal was published in March. The Journal continues to provide a ready source of information on provincial and territorial geoscience organization charts, geological survey expenditures, geological program highlights, mineral development agreements, hard rock drill core storage programs, and other provincial geoscience information. Volume six includes an article on the preparation of the geological atlas of the western Canada sedimentary basin, a multi-institutional, multi-disciplinary compilation. It also initiates an annual review of discovery methods of mines that opened in Canada during the year preceding publication.

The Committee continued its liaison with the Prospectors and Developers Association, organization the Provincial Activities Session and the provincial displays at the PDAC. Seven papers were presented at the Provincial Activities Session:

- Gold Deposits of the Stewart–Iskut River Gold Belt, British Columbia; D.V. Lefebure, Geological Survey Branch, British Columbia Ministry of Energy, Mines and Petroleum Resources
- Mineral Exploration Directed Activities of the Geological Services Branch, Manitoba; G.H. Gale, Manitoba Department of Mines and Energy
- Geographic Information Systems (GIS) at the Ministere de l'Energie et des Ressources du Quebec; L. Chauvin and Jean-Louis Caty (speaker), Quebec Ministere de l'Energie et des Ressources
- The Wawa Gold Camp – the Golden Goods; K.B. Heather, Ontario Geological Survey
- Geological Survey Impact on Mineral Discoveries – the Saskatchewan Experience; R. MacDonald (speaker), L.S. Beck, and T.I. Sibbald, Saskatchewan Energy and Mines
- Industrial Mineral Mining Activities and Development Opportunities in Nova Scotia; J. Fowler, Nova Scotia Department of Mines and Energy
- New Exploration Targets for Gold in Newfoundland and Labrador from Lake Sediment Geochemistry; P. H. Davenport, J.W. McConnell (speaker), A.J. Butler, and L.W. Nolan, Geological Survey Branch, Newfoundland Department of Mines and Energy

All provinces and territories, with the exception of Prince Edward Island, also displayed results of their work in the "provincial room" for the three days of the convention. Discussions were continued with the PDA on a number of topics of mutual interest, including the public image of the mining industry, the availability of land for exploration, and the importance of establishing national standards in geoscience.

The Committee also continued its liaison with the Geological Survey of Canada through the National Geological Surveys Committee. These discussions have led to the formation of three separate subcommittees:

1. to facilitate cooperation and standardization in the development and implementation of Geoscience Information Systems
2. to develop standards for aeromagnetic surveys
3. to review geological map symbols in use in Canada

Results of the work of these subcommittees will be published in the Provincial Geologists Journal. The initial report, that of the subcommittee reviewing map symbols, appears in this volume. The brief of the Committee of Provincial Geologists to the Mines Ministers this year stressed the importance of federal–provincial cooperation in the geosciences. The Committee recommended that the Mines Ministers endorse discussions with the Geological Survey of Canada leading to establishment of formal procedures to ensure such cooperation. The Mines Ministers accepted the recommendation and directed the committee to report on progress at next year's conference.

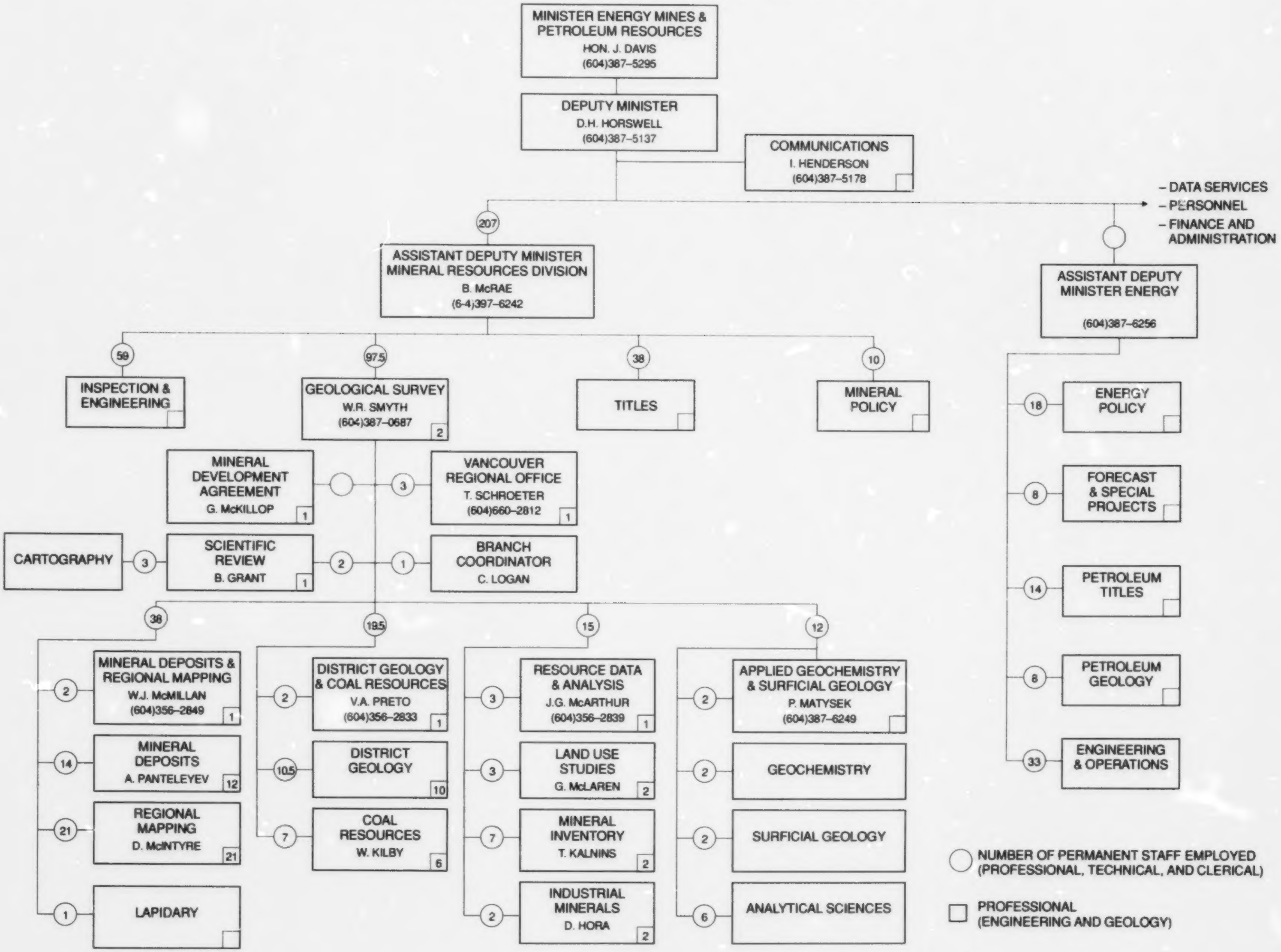
Dr. L.S. Beck, who was one of the founding members of the Committee and who represented Saskatchewan on the Committee for many years, resigned in 1989. The Committee thanks Les for his very significant contributions over the years and wishes him well in the future. The Committee welcomed two new members in 1989; Dr. Bob MacDonald replacing Les Beck as Saskatchewan's representation, and Diana Purdy, representing the Alberta Department of Energy and Natural Resources.

B.A. Green
Chairman

GEOSCIENCE ORGANIZATION CHARTS

Each provincial and territorial government in Canada has developed its own organizational structure for conducting geoscientific survey and research work. Some provinces have what is formally called a Geological Survey (e.g. Ontario Geological Survey), but in most jurisdictions the main elements of the geological survey function are embraced in one or more Branches or Divisions of provincial Mines/Energy/Natural Resources Departments (e.g. the British Columbia Ministry of Energy, Mines and Petroleum Resources is divided into a Mineral Resources Division and a Petroleum Resources Division, with the bulk of geological survey and research work conducted in the Geological Branch of the Mineral Resources Division). The following organization charts are set out in standard format to help alleviate confusion amongst potential users of provincial geoscience services. The charts contain reference to the lines of reporting of the various units in each hierarchy, the manpower associated with each separate jurisdiction, and the names and telephone numbers of key individuals in each system.

BRITISH COLUMBIA GEOSCIENCE ORGANIZATION CHART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D.H. HORSWELL
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– FINANCE AND ADMINISTRATION
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ASSISTANT DEPUTY MINISTER MINERAL RESOURCES DIVISION
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INSPECTION & ENGINEERING
97.5
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2
38
TITLES
10
MINERAL POLICY
18
ENERGY POLICY
8
FORECAST & SPECIAL PROJECTS
14
PETROLEUM TITLES
8
PETROLEUM GEOLOGY
33
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MINERAL DEVELOPMENT AGREEMENT
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1
3
VANCOUVER REGIONAL OFFICE
T. SCHROETER
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CARTOGRAPHY
3
SCIENTIFIC REVIEW
B. GRANT
1
2
1
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C. LOGAN
38
19.5
15
12
2
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1
14
MINERAL DEPOSITS
A. PANTELEYEV
12
21
REGIONAL MAPPING
D. McINTYRE
21
1
LAPIDARY
2
DISTRICT GEOLOGY & COAL RESOURCES
V.A. PRETO
(604)356–2833
1
10.5
DISTRICT GEOLOGY
10
7
COAL RESOURCES
W. KILBY
6
3
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MINERAL INVENTORY
T. KALNINS
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D. HORA
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2
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2
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2
SURFICIAL GEOLOGY
6
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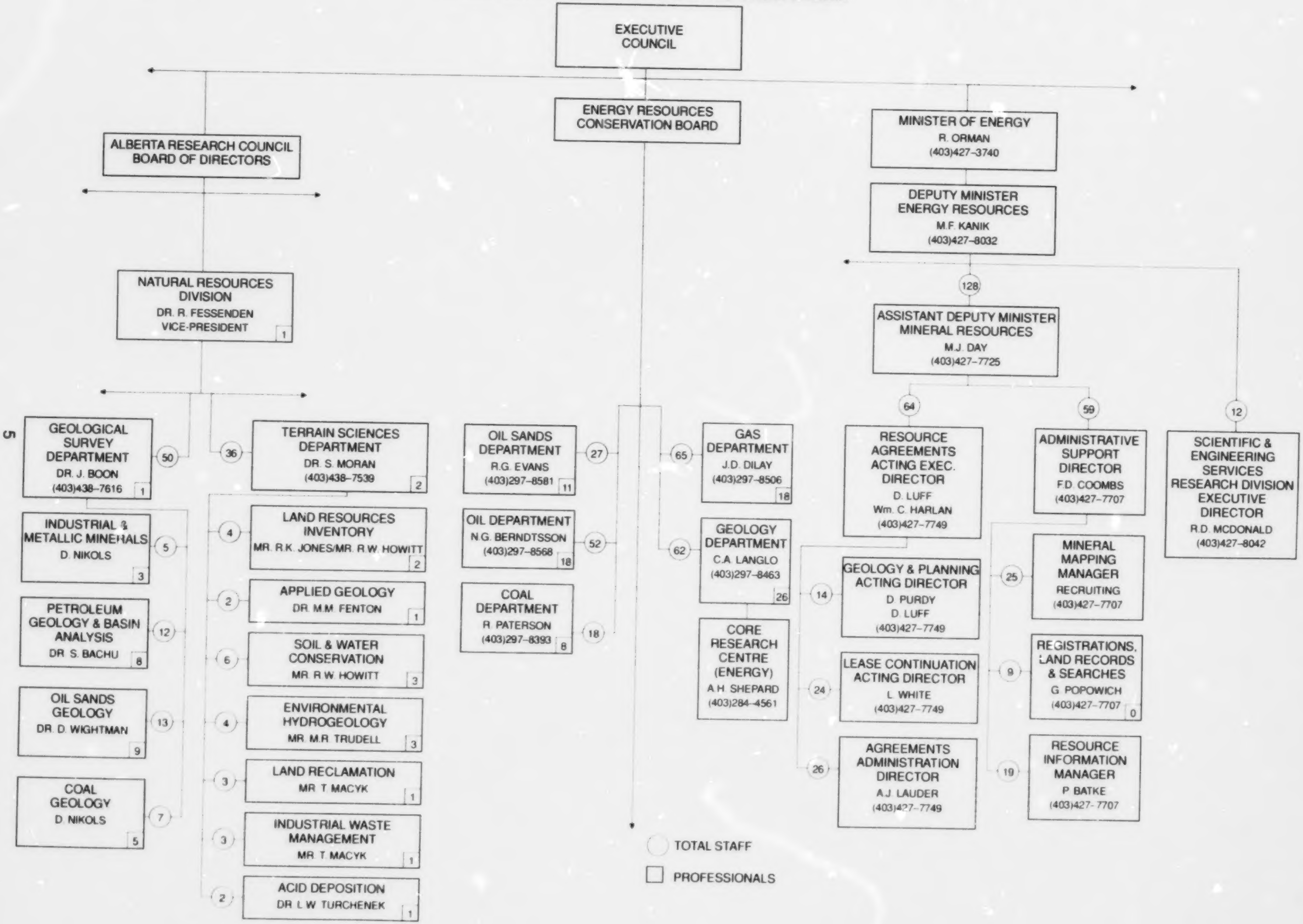
○ NUMBER OF PERMANENT STAFF EMPLOYED (PROFESSIONAL, TECHNICAL, AND CLERICAL)
☐ PROFESSIONAL (ENGINEERING AND GEOLOGY)

ALBERTA GEOSCIENCE ORGANIZATION CHART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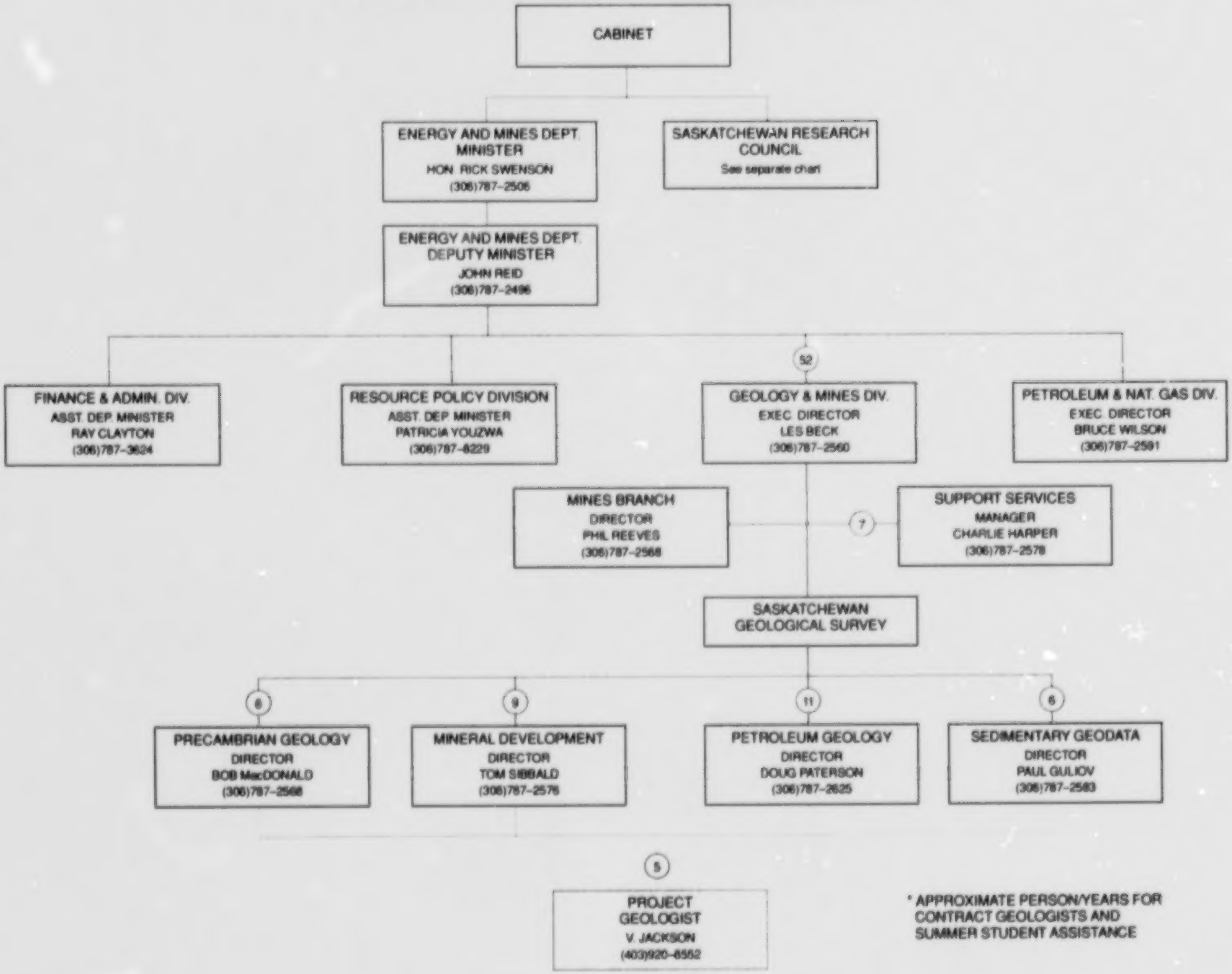
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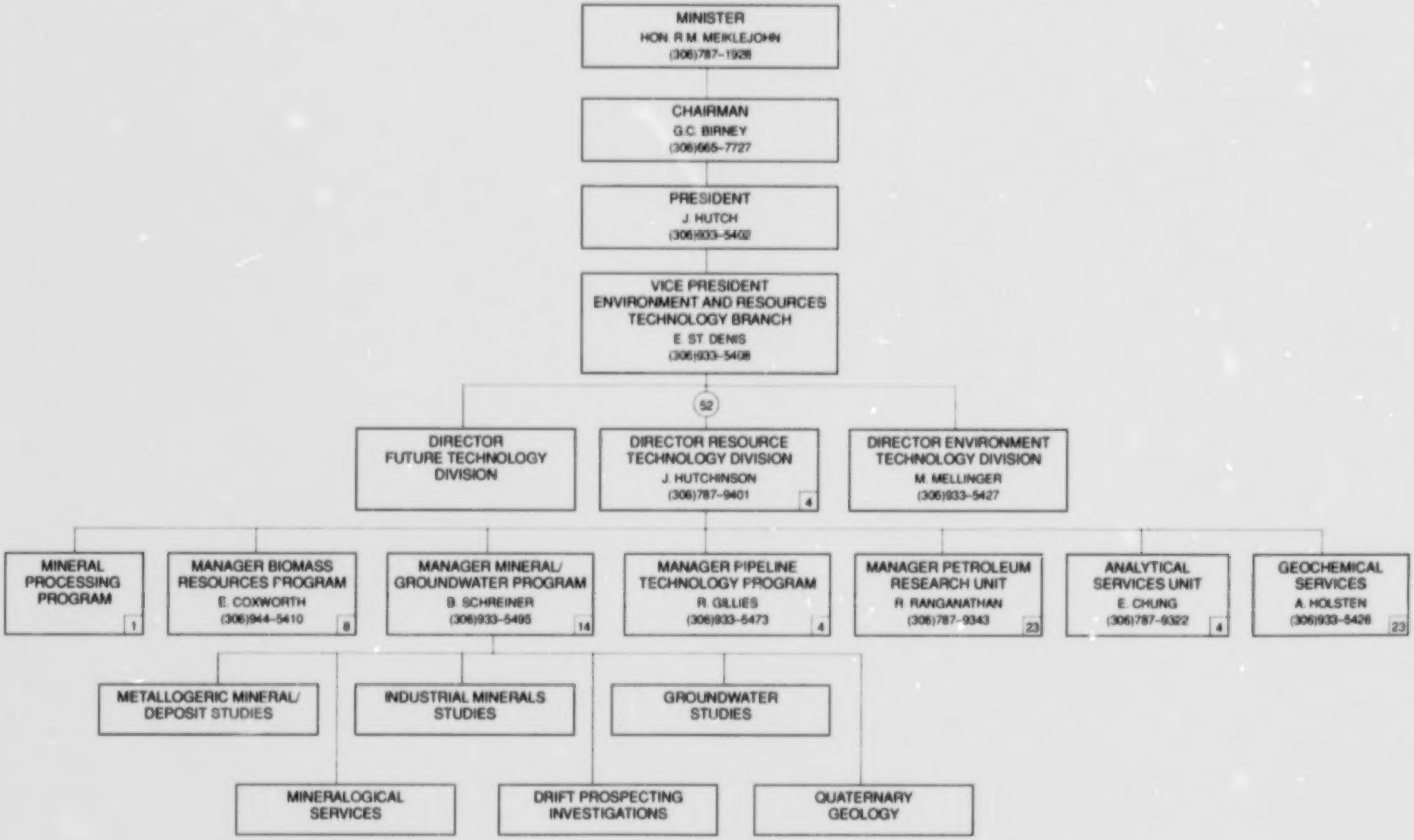
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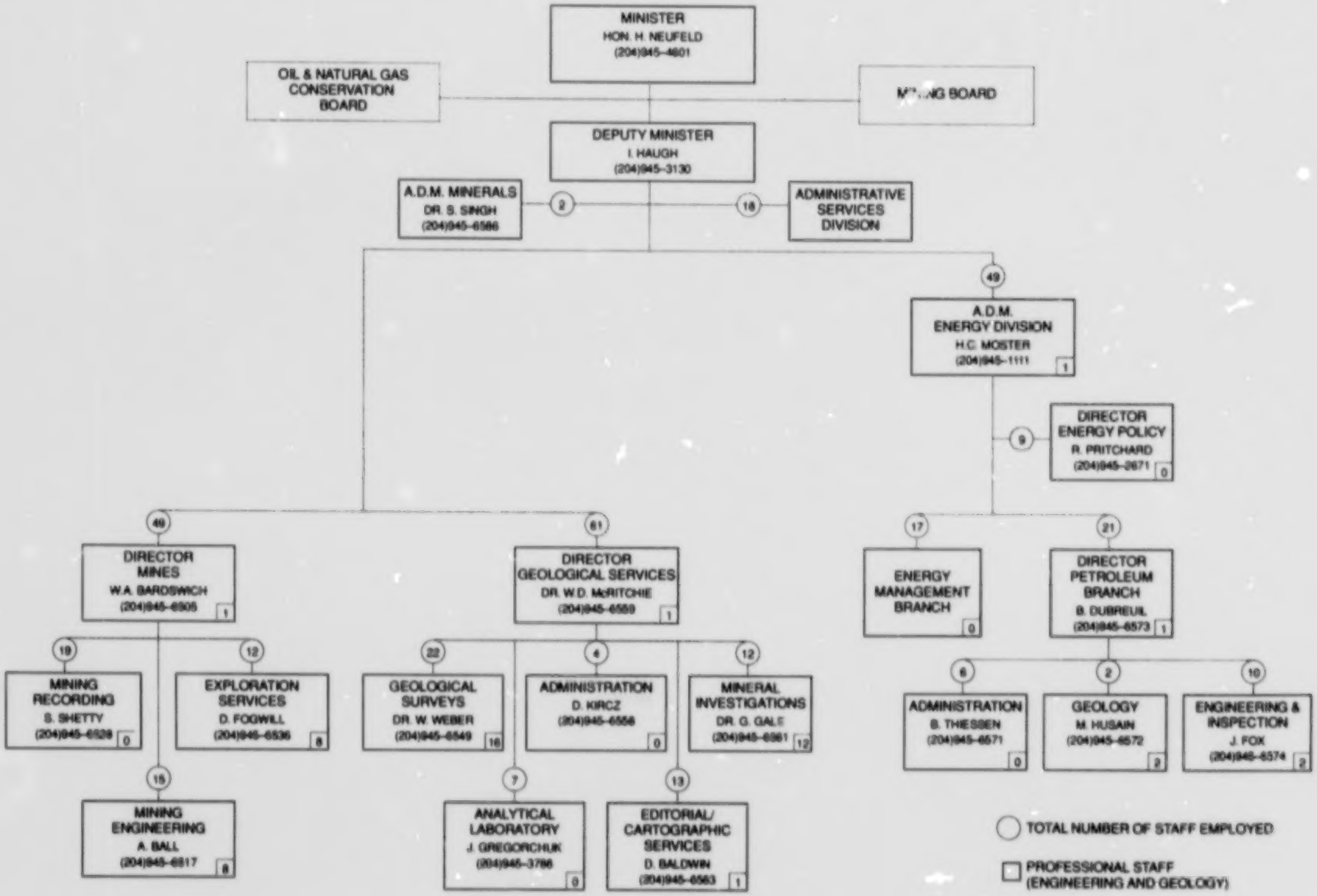
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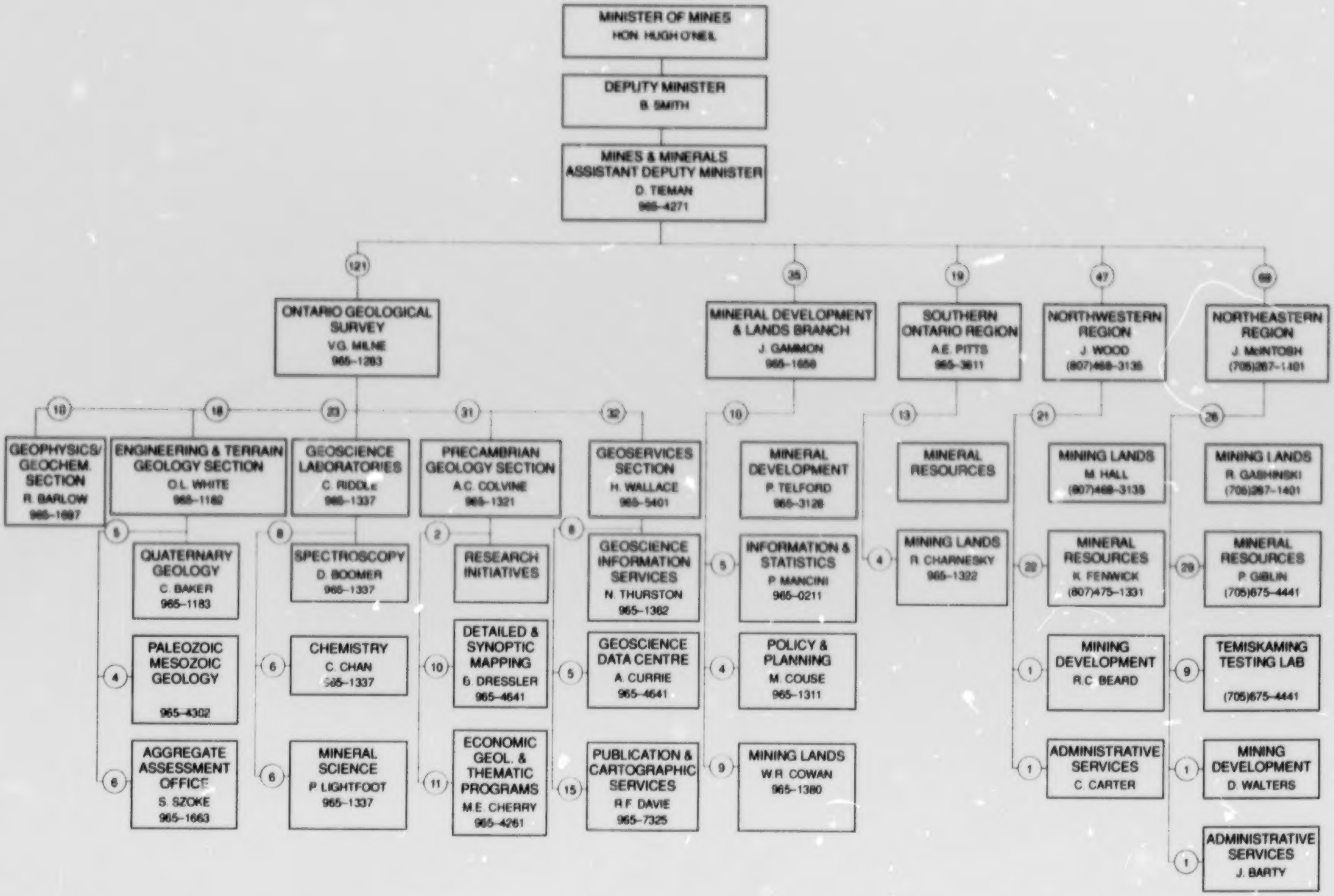
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W.R. COWAN
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13
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M. HALL
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1
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R.C. BEARD
1
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C. CARTER
26
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R. GASHINSKI
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29
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J. BARTY

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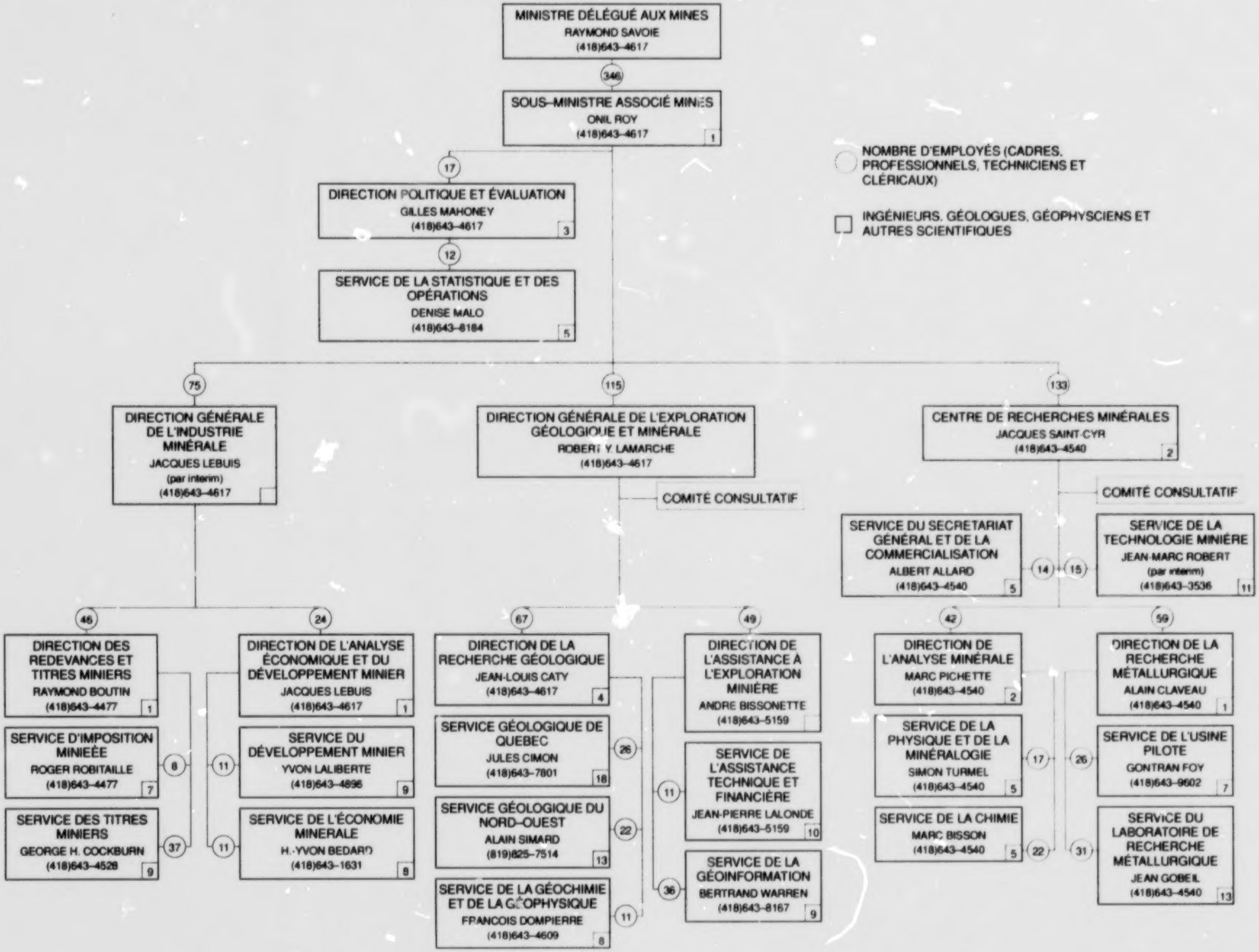
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346
SOUS-MINISTRE ASSOCIÉ MINES ONIL ROY (418)643-4617 1
17
DIRECTION POLITIQUE ET ÉVALUATION GILLES MAHONEY (418)643-4617 3
12
SERVICE DE LA STATISTIQUE ET DES OPÉRATIONS DENISE MALO (418)643-8184 5
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☐ INGÉNIEURS, GÉOLOGUES, GÉOPHYSCIENS ET AUTRES SCIENTIFIQUES
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DIRECTION GÉNÉRALE DE L'INDUSTRIE MINÉRALE JACQUES LEBUIS (par interim) (418)643-4617
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DIRECTION GÉNÉRALE DE L'EXPLORATION GÉOLOGIQUE ET MINÉRALE ROBERT Y. LAMARCHE (418)643-4617
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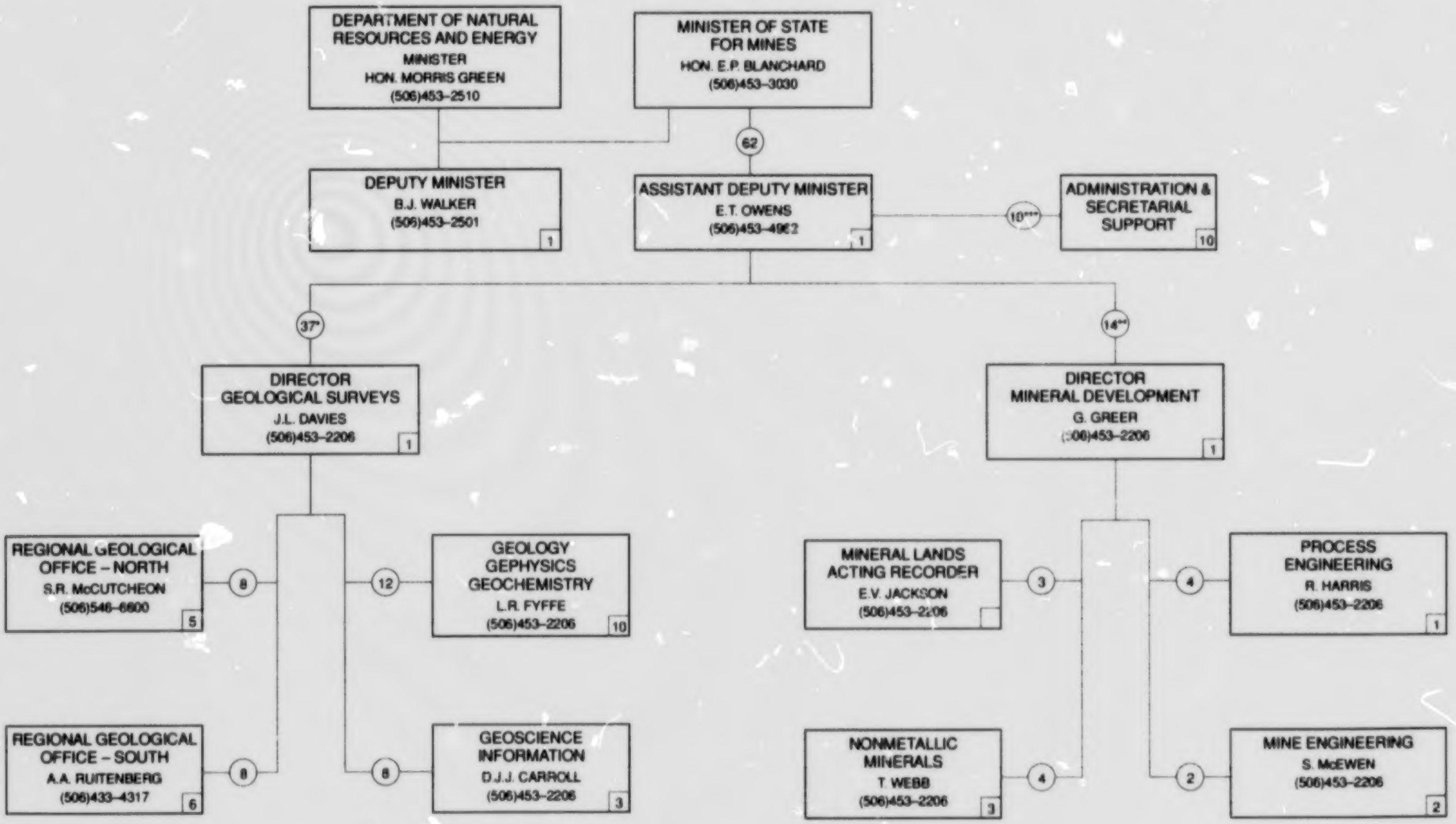
SERVICE GÉOLOGIQUE DU NORD-OUEST ALAIN SIMARD (819)825-7514 13
11
SERVICE DE LA GÉOCHIMIE ET DE LA GÉOPHYSIQUE FRANCOIS DOMPIERRE (418)643-4609 8
49
DIRECTION DE L'ASSISTANCE À L'EXPLORATION MINIÈRE ANDRE BISSONETTE (418)643-5159
11
SERVICE DE L'ASSISTANCE TECHNIQUE ET FINANCIÈRE JEAN-PIERRE LALONDE (418)643-5159 10
36
SERVICE DE LA GÉOINFORMATION BERTRAND WARREN (418)643-8167 9
42
DIRECTION DE L'ANALYSE MINÉRALE MARC PICHETTE (418)643-4540 2
17
SERVICE DE LA PHYSIQUE ET DE LA MINÉRALOGIE SIMON TURMEL (418)643-4540 5
22
SERVICE DE LA CHIMIE MARC BISSON (418)643-4540 5
59
DIRECTION DE LA RECHERCHE MÉTALLURGIQUE ALAIN CLAVEAU (418)643-4540 1
26
SERVICE DE L'USINE PILOTE GONTRAN FOY (418)643-9602 7
31
SERVICE DU LABORATOIRE DE RECHERCHE MÉTALLURGIQUE JEAN GOBEIL (418)643-4540 13

NEW BRUNSWICK GEOSCIENCE ORGANIZATION CHART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MINISTER
HON. MORRIS GREEN
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MINISTER OF STATE FOR MINES
HON. E.P. BLANCHARD
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DEPUTY MINISTER
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ASSISTANT DEPUTY MINISTER
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1
10***
ADMINISTRATION & SECRETARIAL SUPPORT
10
37*
DIRECTOR GEOLOGICAL SURVEYS
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1
14**
DIRECTOR MINERAL DEVELOPMENT
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5
8
12
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GEPHYSICS
GEOCHEMISTRY
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MINERAL LANDS ACTING RECORDER
E.V. JACKSON
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3
4
PROCESS ENGINEERING
R. HARRIS
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REGIONAL GEOLOGICAL OFFICE – SOUTH
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(506)433-4317
6
8
8
GEOSCIENCE INFORMATION
D.J.J. CARROLL
(506)453-2206
3
NONMETALLIC MINERALS
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3
4
2
MINE ENGINEERING
S. McEWEN
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2

* INCLUDES EIGHT GEOLOGISTS AND ONE TYPIST SUPPORTED BY CANADA–NEW BRUNSWICK MINERAL DEVELOPMENT AGREEMENT FUNDS

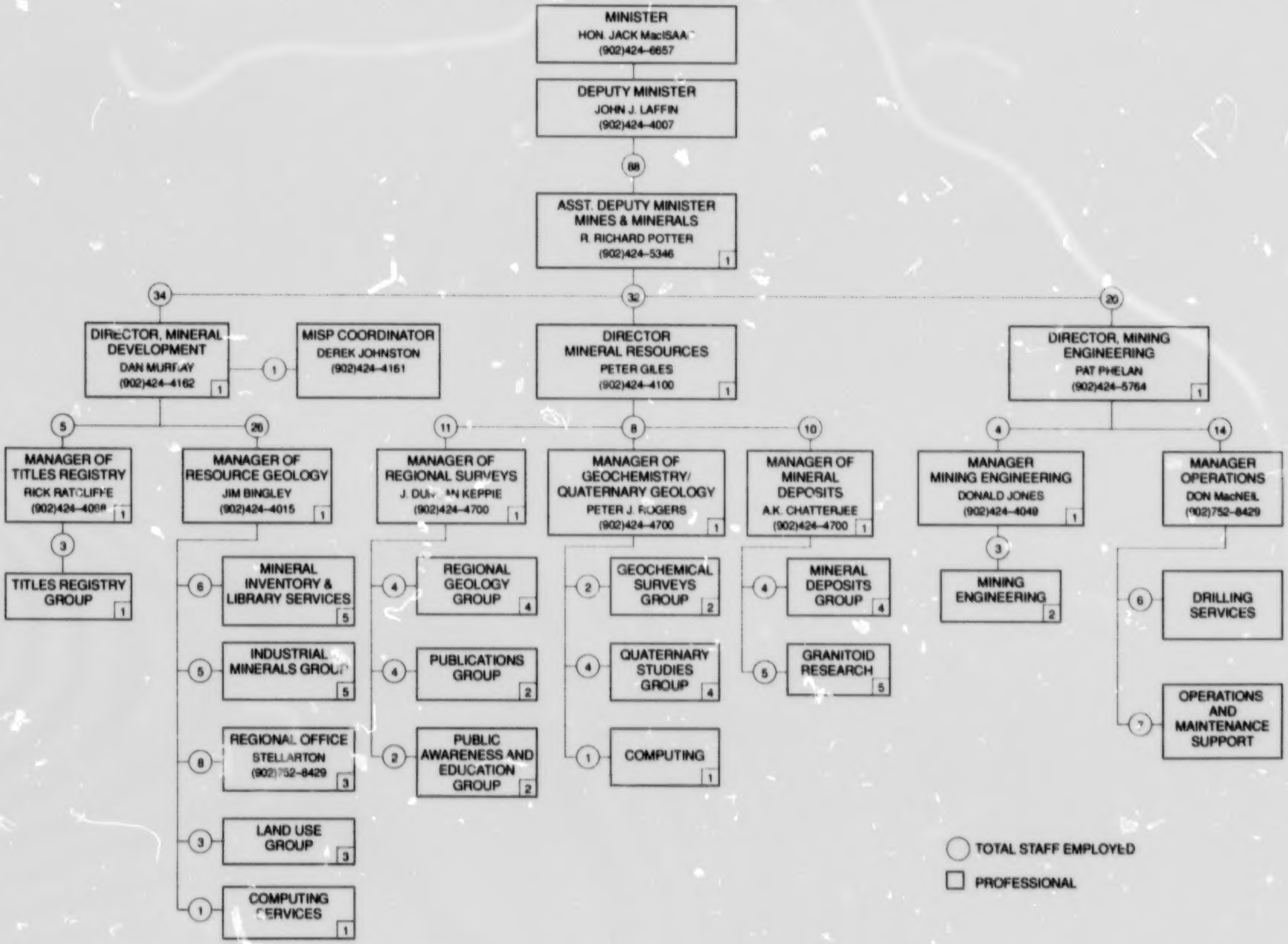
** INCLUDES THREE POSITIONS SUPPORTED BY CANADA–NEW BRUNSWICK MINERAL DEVELOPMENT AGREEMENT FUNDS

*** INCLUDES TWO POSITIONS SUPPORTED BY CANADA–NEW BRUNSWICK MINERAL DEVELOPMENT AGREEMENT FUNDS

○ TOTAL PROFESSIONAL, TECHNICAL, AND CLERICAL STAFF

☐ TOTAL PROFESSIONAL STAFF

NOVA SCOTIA GEOSCIENCE ORGANIZATION CHART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88
ASST. DEPUTY MINISTER MINES & MINERALS
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34
32
20
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MISP COORDINATOR
DEREK JOHNSTON
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1
5
26
11
8
10
4
14
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RICK RATCLIFFE
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1
3
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1
MANAGER OF RESOURCE GEOLOGY
JIM BINGLEY
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1
6
MINERAL INVENTORY & LIBRARY SERVICES
5
5
INDUSTRIAL MINERALS GROUP
5
8
REGIONAL OFFICE
STELLARTON
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3
3
LAND USE GROUP
3
1
COMPUTING SERVICES
1
MANAGER OF REGIONAL SURVEYS
J. DUNCAN KEPPIE
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1
4
REGIONAL GEOLOGY GROUP
4
4
PUBLICATIONS GROUP
2
2
PUBLIC AWARENESS AND EDUCATION GROUP
2
MANAGER OF GEOCHEMISTRY/ QUATERNARY GEOLOGY
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1
2
GEOCHEMICAL SURVEYS GROUP
2
4
QUATERNARY STUDIES GROUP
4
1
COMPUTING
1
MANAGER OF MINERAL DEPOSITS
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1
4
MINERAL DEPOSITS GROUP
4
5
GRANITOID RESEARCH
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MANAGER MINING ENGINEERING
DONALD JONES
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1
3
MINING ENGINEERING
2
MANAGER OPERATIONS
DON MacNEIL
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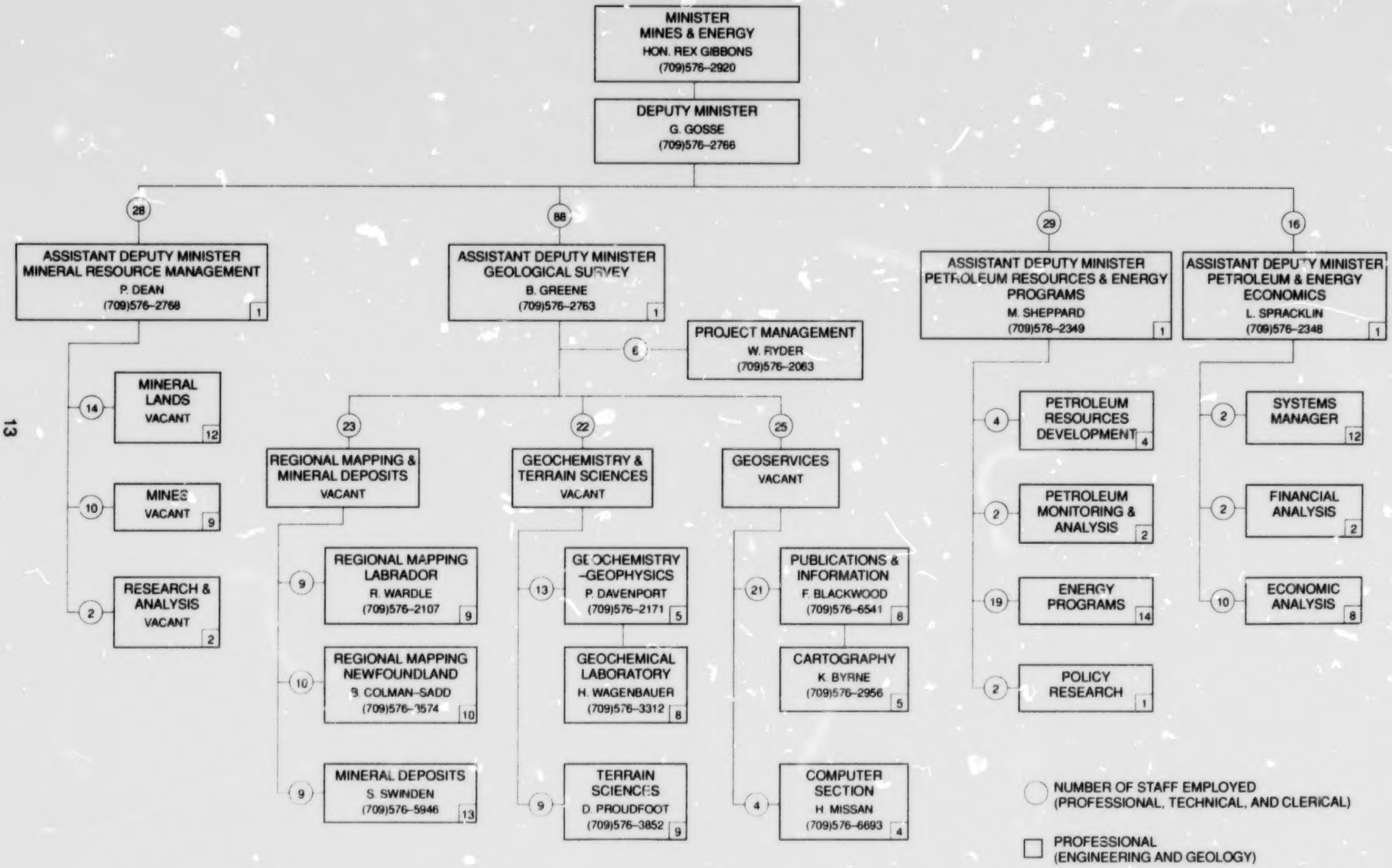
6
DRILLING SERVICES
7
OPERATIONS AND MAINTENANCE SUPPORT
○ TOTAL STAFF EMPLOYED
□ PROFESSIONAL

NEWFOUNDLAND GEOSCIENCE ORGANIZATION CHART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DEPUTY MINISTER
G. GOSSE
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28
ASSISTANT DEPUTY MINISTER
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1
14
MINERAL LANDS
VACANT
12
10
MINES
VACANT
9
2
RESEARCH & ANALYSIS
VACANT
2
88
ASSISTANT DEPUTY MINISTER
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6
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VACANT
9
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R. WARDLE
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9
10
REGIONAL MAPPING NEWFOUNDLAND
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10
9
MINERAL DEPOSITS
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13
22
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VACANT
13
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GEOCHEMICAL LABORATORY
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8
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TERRAIN SCIENCES
D. PROUDFOOT
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9
25
GEOSERVICES
VACANT
21
PUBLICATIONS & INFORMATION
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8
CARTOGRAPHY
K. BYRNE
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5
4
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4
29
ASSISTANT DEPUTY MINISTER
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4
PETROLEUM RESOURCES DEVELOPMENT
4
2
PETROLEUM MONITORING & ANALYSIS
2
19
ENERGY PROGRAMS
14
2
POLICY RESEARCH
1
16
ASSISTANT DEPUTY MINISTER
PETROLEUM & ENERGY ECONOMICS
L. SPRACKLIN
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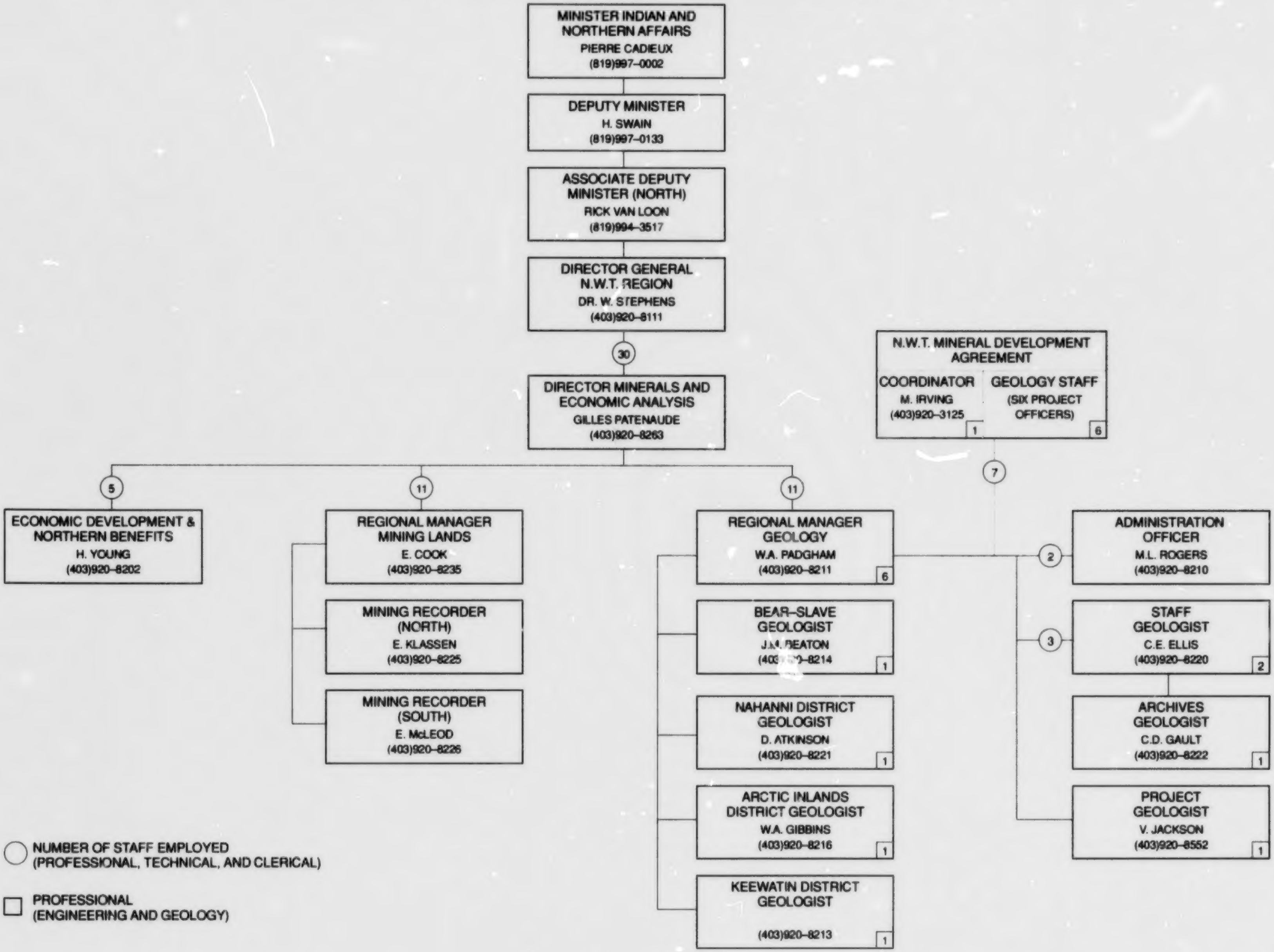
2
SYSTEMS MANAGER
12
2
FINANCIAL ANALYSIS
2
10
ECONOMIC ANALYSIS
8
○ NUMBER OF STAFF EMPLOYED (PROFESSIONAL, TECHNICAL, AND CLERICAL)
☐ PROFESSIONAL (ENGINEERING AND GEOLOGY)

NORTHWEST TERRITORIES GEOSCIENCE ORGANIZATION CHART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ASSOCIATE DEPUTY MINISTER (NORTH)
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DR. W. STEPHENS
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30
DIRECTOR MINERALS AND ECONOMIC ANALYSIS
GILLES PATENAUDE
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N.W.T. MINERAL DEVELOPMENT AGREEMENT
COORDINATOR
M. IRVING
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GEOLOGY STAFF
(SIX PROJECT OFFICERS)
6
7
5
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MINING RECORDER (NORTH)
E. KLASSEN
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MINING RECORDER (SOUTH)
E. McLEOD
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(403)[illegible]–8214
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2
ADMINISTRATION OFFICER
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3
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2
ARCHIVES GEOLOGIST
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1
PROJECT GEOLOGIST
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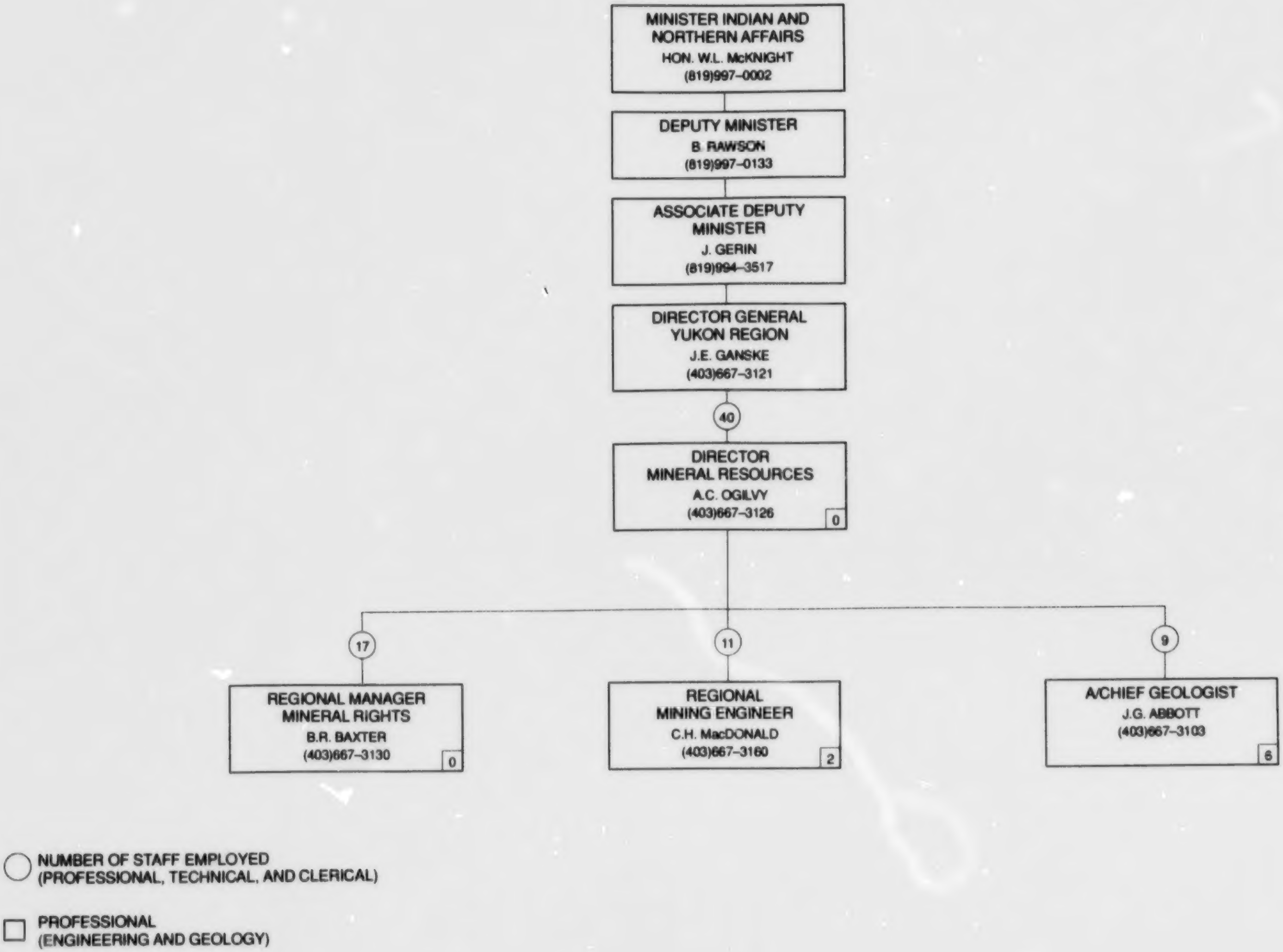
(403)920–8552
1
○ NUMBER OF STAFF EMPLOYED (PROFESSIONAL, TECHNICAL, AND CLERICAL)
☐ PROFESSIONAL (ENGINEERING AND GEOLOGY)

YUKON GEOSCIENCE ORGANIZATION CHART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B. RAWSON
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J. GERIN
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DIRECTOR GENERAL YUKON REGION
J.E. GANSKE
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DIRECTOR MINERAL RESOURCES
A.C. OGILVY
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0
17
REGIONAL MANAGER MINERAL RIGHTS
B.R. BAXTER
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0
11
REGIONAL MINING ENGINEER
C.H. MacDONALD
(403)667–3160
2
9
A/CHIEF GEOLOGIST
J.G. ABBOTT
(403)667–3103
6
○ NUMBER OF STAFF EMPLOYED (PROFESSIONAL, TECHNICAL, AND CLERICAL)
☐ PROFESSIONAL (ENGINEERING AND GEOLOGY)

PROVINCIAL GEOLOGICAL SURVEY EXPENDITURES, 1988–1989

PROVINCIAL GEOSCIENCES EXPENDITURES
1988 – 1989

PROVINCE/ TERRITORY	SURVEY EXPENDITURES $ X 10^6	% OF TOTAL	TOTAL 1988 VALUE OF PROVINCIAL MINERAL PRODUCTION[1] $ X 10^3	SURVEY EXPENDITURES AS % OF TOTAL VALUE OF PROVINCIAL MINERAL PRODUCTION	AREA OF PROVINCE/ TERRITORY KM^2 X 10^3	SURVEY $ SPENT/KM^2	POPULATION (1986) X 10^3	SURVEY $ SPENT/ CAPITA
NEWFOUNDLAND	4.7	5.6	888 476	.53	405	11.6	568	8.3
NOVA SCOTIA	5.8	7.0	253 243	2.29	55	105.5	873	6.6
PRINCE EDWARD ISLAND	-	-	2 825	-	6	-	127	-
NEW BRUNSWICK	2.8	3.4	797 158	.35	73	38.4	709	4.0
QUEBEC	20.7	24.8	2 718 152	.76	1 541	13.4	6 532	3.2
ONTARIO	21.3	25.7	7 069 265	.30	1 069	19.9	9 102	2.3
MANITOBA	3.3	4.0	1 597 389	.21	650	5.1	1 063	3.1
SASKATCHEWAN	3.7	4.5	1 624 043	.23	652	5.7	1 010	3.7
ALBERTA	9.6	11.6	750 966	1.28	661	14.5	2 366	4.1
BRITISH COLUMBIA	8.8	10.6	2 306 477	.38	948	9.3	2 883	3.0
YUKON	1.0	1.2	466 530	.21	483	2.1	24	41.7
NORTHWEST TERRITORIES	1.3	1.6	768 157	.17	3 380	0.4	52	25.0
TOTALS	**83.0**	**100.0**	**19 242 681**	-	**9 923**	-	**25 309**	-

[1] Source : Canadian Mining Journal, March 1989

PROVINCE: BRITISH COLUMBIA
1988-1989

PROGRAMS	SURVEY RESEARCH AGENCY	FUNDING AGENCY	NO. OF PROJECTS (OR FACILITIES)	PERMANENT SMY	CASUAL SMY	PERMANENT $	CASUAL TEMPORARY $	OPERATING EXPENDITURES $	TOTALS
Chief's Office	GSB (MRD)	EMPR	-	2	-	87 000	-	115 000	202 000
		MDA	-	-	1	-	45 000	5 000	50 000
Geoscience Grants	"	EMPR	32	-	-	-	-	150 000	150 000
		MDA	11	-	-	-	-	50 000	50 000
Geochemistry	"	EMPR	1	1	2	45 000	80 000	499 000	624 000
		MDA	2	-	2	-	50 000	200 00	250 000
Regional Mapping	"	EMPR	6	3	15	125 000	500 000	725 000	1 350 000
		MDA	4	-	9.5	-	360 000	239 000	599 000
Mineral Deposits	"	EMPR	6	13	-	490 000	-	683 000	1 173 000
		MDA	1	-	2	-	73 000	101 000	174 000
Coal Resources	"	EMPR	9	6	-	261 000	-	320 000	581 000
Industrial Minerals	"	EMPR	2.5	2	1	81 000	24 000	147 000	252 000
		MDA	1.5	-	2	-	50 000	89 000	139 000
Prospectors Assistance and Training (FAME)	"	EMPR	137	-	2	-	50 000	450 000	500 000
Land Use	"	EMPR	1	2	-	73 000	-	106 000	179 000
Mineral Deposits Inventory and Analysis	"	EMPR	2.5	8	-	235 000	not avail.	396 000	631 000
		MDA	0.5	-	2	-	73 000	21 000	94 000
District Geology	"	EMPR	7	9	-	360 000	not avail	462 000	822 000
		MDA	-	-	1	-	27 000	-	27 000
Scientific Review	"	EMPR	-	2	-	60 000	-	-	60 000
Publications	"	EMPR	-	-	-	-	-	230 000	230 000
Laboratory Analysis	"	EMPR	-	6	-	200 000	-	175 000	375 000
Oil and Gas Inventory and Analysis	GB (ERD)	EMPR	1	4	0.5	175 000	25 000	40 000	240 000
Petroleum Sursurface Investigations	GB (ERD)	EMPR	1	2	1	96 000	45 000	33 500	174 500
TOTALS									
GSB(MRD)	-	-	-	54	21	2 017 000	604 000	4 008 000	**6 629 000**
MDA	-	-	-	-	16.5	-	678 000	705 000	**1 383 000**
GB (ERD)	-	-	-	6	1.5	271 000	70 000	73 000	**414 500**
FAME	-	-	-	-	2	-	50 000	450 000	**500 000**

GSB (MRD) – Geolgocial Survey Branch (Mineral Resources Division)
GB (ERD) – Geolgocial Branch (Energy Resources Division)
EMPR – Minsitry of Energy, Mines and Petroleum Resources
MDA – Canada - B.C. Mineral Development Agreement
FAME – Financial Assistance for Mineral Exploration
RGS – Regional Geochemical Survey

PROVINCE: ALBERTA
1988-1989

PROGRAMS	SURVEY RESEARCH AGENCY	FUNDING AGENCY	NO. OF PROJECTS (OR FACILITIES)	PERMANENT SMY	CASUAL SMY	SALARIES PERMANENT $	SALARIES CASUAL $	SUPPLIES AND SERVICES $
Chief's Office	ARC/ERCB	ARC/ERCB	2	5.00	-	330.6	-	28.2
Core Repositories	ARC/ERCB	AE	2	40.76	.23	1 098.9	7.0	15.9
Geochemical Research/Survey	-	-	-	-	-	-	-	-
Geological Survey, Bedrock:	ARC	ARC	-	-	-	-	-	-
1) Reconnaissance (1:100 000)	-	-	1	.06	-	4.0	-	.1
2) Detailed (1:50 000)	-	-	-	-	-	-	-	-
Geological Surveys, Surficial:								
1) Reconnaissance	ARC	ARC/AFLW/SRC	10	2.54	1.21	193.9	37.8	74.9
2) Detailed	ARC	ARC	-	-	-	-	-	-
3) Reclamation/Environmental Impact	ARC	ARC, CMRC STANLEY ENG.	10	7.23	1.37	536.2	70.7	174.1
Geophysical	-	-	-	-	-	-	-	-
Hydrogeological	ARC	ARC/AENV	5	2.11	-	222.8	-	87.4
Information and Education	ARC	AOSTRA/ARC	1	.38	-	27.3	-	4.1
Laboratory Analysis	ARC	ARC	1	1.32	-	90.5	-	8.3
Mineral Deposit Inventory and Analysis	ARC	ARC	9	1.85	.28	161.2	9.1	59.8
Energy Resource Inventory and Research:								
1) Petroleum and Natural Gas	ARC/ERCB	ARC/ERCB	6	32.91	1.49	1 402.3	50.7	520.7
2) Oil Sands	ARC/ERCB	ARC/AOSTRA AE/ERCB	8	24.29	1.10	1 374.3	38.2	462.5
3) Coal Geology	ARC	ARC/AE	6	8.10	1.19	630.9	54.4	192.1
Stratigraphic Research	ARC/ERCB	ARC/ERCB	3	7.15	.62	428.5	20.5	147.2
Other	ARC/ERCB	ARC/ERCB	9	14.07	.34	728.5	19.7	331.1
TOTALS	-	-	**73**	**147.68**	**7.83**	**7 229.9**	**308.1**	**2 106.4**

ARC – Alberta Research Council
AOSTRA – Alberta Oil Sands Technical Research Authority
AE – Alberta Department of Energy
AFLW – Alberta Forestry, Lands and Wildlife
AENV – Alberta Environment
ERCB – Energy Resources Conservation Board
CMCR – Coal Mining Research Centre
SRC – Saskatchewan Research Council

PROVINCE: SASKATCHEWAN
1988-1989

PROGRAMS	SURVEY RESEARCH AGENCIES	FUNDING AGENCY	NO. OF PROJECTS (OR FACILITIES)	PERMANENT SMY	CASUAL SMY	SALARIES PERMANENT $	SALARIES CASUAL/ TEMPORARY $	OPERATING EXPENDITURES $
Administration	SGS	SGS	5	7.0	-	325 000	-	40 000
	SRC	SRC	(No figures)	-	-	-	-	-
Core Repositories (Phanerozoic)	SGS	SGS	1	6.0	1.25	110 000	25 000	48 000
(Precambrian)	SGS	SGS	1	-	0.33	-	12 500	8 000
Geochemical Surveys (Bedrock)	SGS/UofR	2	-	-	-	-	-	12 000
(Surficial/Drift Prospecting)	SRC	SRC	2	-	-	40 000	-	-
Geological Surveys, Bedrock:								
1) Reconnaissance (1:100 000)	SGS	SGS	-	-	-	-	-	-
2) Detailed (1:20 000)	SGS	SGS	3	3.0	3.67	152 000	91 500	85 000
3) Compilation (1:250 000)	SGS	SGS	1	-	0.33	-	8 000	1 000
Geological Surveys, Surficial	SRC	SRC	-	-	-	4 000	-	90 000
Geophysical Surveys	-	-	-	-	-	-	-	-
Hydrogeological Surveys	SRC	SRC	-	1.0	-	40 000	-	75 000
Information and Education	SGS	SGS	1	1.0	-	48 000	-	2 000
Laboratory Analyses and Studies:								
(Isotope Geology/Geochronology	UofR/UofS/ UofK/UofC	SGS/UofK/ UofC	3	-	-	-	-	122 000
(P-T-t Studies)	UofND	SGS/UofND	1	-	-	-	-	8 000
(Various)	SRC	SRC	-	1.0	-	40 000	-	40 000
Mineral Deposit Inventory and Analysis	-	-	-	-	-	-	-	-
including Industrial Minerals and	-	-	-	-	1.00	-	30 000	-
Metallogenic Maps	SGS	SGS	7	6.0	2.00	300 000	45 000	70 000
	SRC	SRC	8	4.0	-	120 000	-	200 00
Oil and Gas Inventory and Analysis	SGS	SGS	-	4.0	0.50	116 000	12 000	20 000
Publications and Cartography	SGS/SRC	SGS/SRC	-	6.0	-	295 000	-	102 000
Resident Geologist's Office	SGS	SGS	1	3.0	0.33	115 000	9 000	25 000
Subsurface (Stratigraphy) Studies	SGS	SGS	3	4.0	-	245 000	-	45 000
Water Resource Inventory and Analysis	SRC	SRC	10	4.3	-	160 000	-	100 000
Metallogenic Mineral Deposit Studies	SGS/UofR	SGS	7	1.0	0.66	60 000	15 000	35 000
	SRC	SRC	7	2.0	-	60 000	-	80 000
TOTALS	-	-	**63.0**	**53.3**	**10.1**	**2 266 000**	**248 000**	**1 208 000**

GRAND TOTAL ***$3 722 000***

SGS – Saskatchewan Geological Survey; SRC - Saskatchewan Research Council
UofR – University of Regina; UofS - University of Saskatchewan; UofK - University of Kansas
UofC – University of California (Santa Cruz Campus); UofND - University of North Dakota

PROVINCE: MANITOBA
1988-1989

PROGRAMS	SURVEY RESEARCH AGENCY	FUNDING AGENCY	NO. OF PROJECTS (OR FACILITIES)	PERMANENT SMY	CASUAL/TERM SMY	SALARIES PERM $	SALARIES CASUAL $	OPERATING EXPENDITURES $	TOTAL
Core Repositories	MM	MAN	1	.26	-	18 900	-	8 400	27 300
Geochemical Surveys									
1) Bedrock	-	-	-	-	-	-	-	-	-
2) Drainage	-	-	-	-	-	-	-	-	-
3) Soil	MGS	MAN	1	1.00	1.08	56 500	26 300	19 000	101 800
4) Peat	-	-	-	-	-	-	-	-	-
Geological Surveys, Bedrock									
1) Reconnaissance (1:100 000)	MGS	MAN	1	.26	-	24 500	-	-	24 500
2) Detailed (1:50 000)	MGS	MAN	12	9.26	2.06	480 300	40 600	108 700	629 600
3) Phanerozoic	MGS	MAN	3	.44	1.00	50 000	28 600	32 200	110 800
Geological Surveys (1:50 000)									
1) Reconnaissamce (1:50 000)	-	-	-	-	-	-	-	-	-
2) Detailed (1:50 000)	-	-	-	-	-	-	-	-	-
3) Resource Management	-	-	-	-	-	-	-	-	-
Geophysical Surveys									
1) Airborne Electromagnetic	-	-	-	-	-	-	-	-	-
2) Airborne Magnetic, Gradiometer	-	-	-	-	-	-	-	-	-
3) Ground Magnetic	-	-	-	-	-	-	-	-	-
4) Gravity	-	-	-	-	-	-	-	-	-
5) Seismic	-	-	-	-	-	-	-	-	-
6) Radiometric	-	-	-	-	-	-	-	-	-
7) Remote Sensing	-	-	-	-	-	-	-	-	-
Hydrogeological Surveys	-	-	-	-	-	-	-	-	-
Information, Education, Assessment Services and Compilation	MGS/MM	MAN	9	3.26	3.00	172 300	85 600	28 700	286 600
Laboratory Analysis	MGS	MAN	3	10.35	3.00	352 100	78 700	67 900	498 700
Mineral Deposit Inventory and Analysis	MGS/UNIV	MAN	17	5.00	6.25	259 700	159 900	168 000(2)	587 600
Industrial Minerals	MGS	MAN	3	1.00	1.38	45 600	56 500	14 100	116 200
Oil, Gas Inventory and Analysis									
Publications	MGS	MAN	40	-	-	-	-	62 900	62 900
Resident Geologist's Office	-	-	-	-	-	-	-	-	-
Subsurface Invest, Indust Min Drilling and Management	MGS	MAN/GSC	1	.17	.17	12 200	10 700	19 700	42 600
Water Resource Inventory and Analysis	-	-	-	-	-	-	-	-	-
Other:									
1) Administration	MGS	MAN	-	4.00	2.06	138 300	44 000	190 200(1)	372 500
2) Drafting	MGS	MAN	-	9.44	1.34	341 800	59 600	19 800	421 200
3) Uranium/Lead and Rubidium/ Strontium Analyses	MGS/UNIV GSC	MAN	3	-	-	-	-	5 100	5 100
TOTALS	-	-	-	**46.36**	**22.30**	**1 952 200**	**590 500**	**744 700**	**3 287 400**

MGS – Manitoba Geological Services Branch
MM – Manitoba Mines Branch
UNIV – Universities
(1) – Includes 98.8 for Field Equipment and Capital
(2) – Includes U of M Agreements 54.0

PROVINCE: ONTARIO
1988-1989

PROGRAMS	FUNDING AGENCY	NO. OF PROJECTS (OR FACILITIES)	PERSON-YEARS PERMANENT	CASUAL	SALARIES PERMANENT $	CASUAL	OPERATING EXPENDITURES $	TOTALS $
Administration (Director's Office OGS)	MNDM	-	7	2	337.4	53.3	302.7	693.4
Libraries	MNDM	7	8	1	275.1	30.5	150.3	455.9
Geophysical Airborne Electromagnetic Surveys	NDF	2	-	3	-	111.9	2 007.6	2 119.5
Other Geophysical Surveys/Research	MNDM	1	10	3	429.3	151.0	414.0	994.3
Geochemical Surveys/Research	MNDM	2						
Geological Surveys:								
Precambrian	MNDM	44	30	20	1 419.4	556.1	986.8	2 962.3
Phanerozoic	MNDM	7						
Quaternary	MNDM	4	18	7	664.7	232.1	383.4	1 280.2
Aggregate	MNDM	2						
Geoservices (OGS)								
Publications	MNDM	-	15	5	450.9	155.1	607.5	1 213.5
Laboratory Analysis	MNDM	-	23	2	864.2	46.8	607.1	1 518.1
Equipment, Vehicles	MNDM	-	4	3	199.7	90.3	518.0	808.0
Information, Education, Library, Assessment Files	MNDM	-	13	4	414.4	124.0	412.4	950.8
Resident Geologist's Office	MNDM	17	64	10	1 826.8	291.6	722.8	2 841.2
Geoscience Research Grants Programs	MNDM	26	-	-	-	-	462.6	462.6
Other Geological Research Grants	MNDM	8	-	-	-	-	407.6	407.6
COMDA	CAN/ONT	61	-	71	-	3 001.4	1 589.7	4 591.1
TOTALS	-	-	**192**	**131**	**6 881.9**	**4 844.1**	**9 572.5**	**21 298.5**

MNDM - Ministry of Northern Development and Mines
COMDA - Canada-Ontario 1985 Mineral Development Subsidiary Agreement
NDF - Ontario Northern Development Fund
OGS - Ontario Geological Survey

Note: $ Values in 1,000's

PROVINCE: **QUÉBEC**
1988-1989

PROGRAMS	MATRE D'OEUVRE	FINANCEMENT	NOMBRE DE PROJETS OU D'INSTALLATIONS	EMPLOYÉS PERMANENTS PERS.-ANNÉE (C-P-A-)**	EMPLOYÉS OCCASIONNELS PERS.-ANNÉE	BUDGET ALLOUÉ
Levés géologiques	DGEGM	MER/EMR*	-	-	-	-
1) Côte-Nord et Nouveau-Québec	DGEGM	MER/EMR*	22	4P-1A	2	2 404 800
2) Montréal-Laurentides	DGEGM	MER/EMR*	5	3P-1A	2	407 700
3) Gaspésie-Les Iles	DGEGM	MER/EMR*	9	2P-1A	2	802 100
4) Estrie-Laurentides	DGEGM	MER/EMR*	13	4P-2A	1	725 000
5) Minéraux Industriels du Québec	DGEGM	MER/EMR*	14	3P-1A	3	479 900
6) Rouyn-Noranda	DGEGM	MER/EMR*	9	3P-3A	1	882 200
7) Val-d'Or	DGEGM	MER/EMR*	4	3P-3A	3	572 900
8) Chibougamau	DGEGM	MER/EMR*	7	3P-2A	1	778 700
9) Gites minéraux du Nord-Ouest	DGEGM	MER/EMR*	13	3P	-	879 000
Levés géochimiques	DGEGM	MER/EMR*	24	3P-2A	1	1 048 300
Levés géophysiques	DGEGM	MER/EMR*	14	3P	-	781 600
Opérations (équipement de terrain, informatique, etc.)	DGEGM	MER	-	2P-3A	6	1 981 200
Assistance financière	DGEGM	MER/EMR*	20	1C-1P-2A	4	3 580 600
Géoinformation	DGEGM	MER/EMR*	-	1C-14P-27A	7	3 956 100
Promotion	DGEGM	MER	-	1A	-	373 300
Administration	-	MER	-	6C-3P-7A	6	1 061 500
TOTAUX	-	-	-	**8C-54P-56A**	**39**	**20 714 900**

DGEGM – Direction générale de l'exploration géologique et minérale
MER – Ministère de l'Energie et des Ressources du Québec
EMR – Energy, Mines and Resources, Ottawa
* – Entente auxiliaire Canada-Québec sur le développement minéral
** – C = cadre
P = professionnel
A = autre

PROVINCE: NEW BRUNSWICK
1988-1989

				STAFF-YEARS			SALARIES			
PROGRAMS	**SURVEY RESEARCH AGENCY**	**FUNDING AGENCY**	**NO. OF PROJECTS (OR FACILITIES)**	**PERMANENT**	**CONTINUING AUXILIARY**	**SUMMER AUXILIARY**	**PERMANENT $**	**CONTINUING AUXILIARY $**	**SUMMER AUXILIARY $**	**OPERATING EXPENDITURES $**
Core Repositories	GSB	DNRE	5	1	-	1.0	43 000	-	23 000	64 000
Geochemical Surveys:										
1) Bedrock	-	-	3	-	4	1.0	-	77 000	12 000	132 000
2) Drainage	GSB	DNRE	1	-	-	-	-	-	-	50 000
3) Soil	-	-	-	-	-	-	-	-	-	-
Geological Surveys, Bedrock:										
1) Reconnaissance (1:100 000)	-	-	-	-	-	-	-	-	-	-
2) Detailed (1:20 000)	GSB	DNRE	4	3	2	2.0	168 000	98 000	24 000	300 000
Geological Surveys; Surficial:										
1) Reconnaissance (1:100 000)	-	-	-	-	-	-	-	-	-	-
2) Detailed (1:50 000)	-	-	3	-	2	2.0	41 000	42 000	15 000	43 000
Geophysical Surveys:										
1) Airborne Electromagnetic	-	-	-	-	-	-	-	-	-	-
2) Airborne Magnetic	-	-	-	-	-	-	-	-	-	-
3) Ground Electromagnetic	-	-	-	-	-	-	-	-	-	-
4) Gravity	-	-	-	-	-	-	-	-	-	-
5) Seismic	-	-	-	-	-	-	-	-	-	-
6) Radiometric	-	-	-	-	-	-	-	-	-	-
Hydrogeological Surveys	-	-	-	-	-	-	-	-	-	-
Information and Education	GSB	DNRE	2	3	-	0.25	95 000	-	-	14 000
Laboratory Analysis	GSB	DNRE	1	2	-	0.25	60 000	-	3 000	15 000
Metallic - Mineral Deposit Inventory and Analysis	MDB	DNRE	2	1	3	0.25	45 000	85 000	3 000	38 000
Industrial Minerals										
1) Evaporites	MDB	DNRE	1	0.5	-	-	23 500	-	-	7 500
2) Limestone	MDB	DNRE	1	0.5	-	-	23 500	-	-	7 500
3) Granular Resources	MDB	DNRE	1	1	-	0.25	30 000	-	3 000	10 000
Coal Inventory and Analysis	-	-	1	1	-	-	38 000	-	-	20 000
Oil and Gas-Oil Shale Inventory and Analysis	MDB	DNRE	2	1	-	-	63 000	-	-	62 000
Publications	GSB	DNRE	1	4	2	-	96 000	5 000	-	31 000
Resident Geologist's Office	GSB	DNRE	2	9	-	1.0	244 000	-	14 000	234 000
Subsurface Investigations	-	-	-	-	-	-	-	-	-	-
Peat Inventory	MDB	DNRE	1	1	-	0.25	43 000	-	4 000	10 000
Water Resource Inventory and Analysis	-	-	-	-	-	-	-	-	-	-
Other Studies*	GSB	DNRE	1	-	-	-	-	100 000	-	250 000
TOTALS	-	-	**33**	**28**	**13**	**8.25**	**1 011 000**	**407 000**	**101 000**	**1 288 000**

GRAND TOTALS ***$2 807 000***

GSB - Geological Surveys Branch
MDB - Mineral Development Branch
DNRE - Department of Natural Resources and Energy
* Includes mineral ecomonic, and mining studies and various research projects supported by GSB

PROVINCE: **NOVA SCOTIA**
1988-1989

PROGRAMS	SURVEY RESEARCH AGENCY	FUNDING AGENCY	NO. OF PROJECTS (OR FACILITIES)	PERMANENT STAFF MAN-YEARS	CASUAL STAFF MAN-YEARS	BUDGET ALLOCATIONS $
Core Repositories	NSDME	NSDME/NSDOD	3	3	1	311 000
Geochemical Surveys:	NSDME	NSDME/NSDOD	2	3	1	130 400
1) Bedrock	-	-	-	-	-	-
2) Drainage	-	-	-	-	-	-
3) Soil	-	-	-	-	-	-
Geological Surveys, Bedrock:						
1) Reconnaissance (1:100 000)	-	-	-	-	-	-
2) Detailed (1:50 000)	NSDME	NSDME/NSDOD	3	8	2	666 000
Geological Surveys, Surficial:						
1) Reconnaisance (1:100 000)	-	-	-	-	-	-
2) Detailed (1:50 000)	NSDME	NSME/NSDOD	2	4	1	260 700
Geophysical Surveys:						
1) Airborne Radiometrics	-	-	-	-	-	-
2) Airborne Magnetic (includes VLF-EM)	-	-	-	-	-	-
3) Ground Magnetic	-	-	-	-	-	-
4) Gravity	-	-	-	-	-	-
5) Siesmic	-	-	-	-	-	-
Hydrogeological Surveys	-	-	-	-	-	-
Information and Education	NSDME	NSDME/NSDOD	2	4	2	697 400
Laboratory Analysis	-	-	-	-	-	-
Mineral Deposit Analysis	NSDME	NSDME/NSDOD	9	6	2	1 024 700
Mineral Deposit	NSDME	NSDME/NSDOD	3	4	1	100 000
Coal and Peat	NSDME	NSDME/NSDOD	4	7	2	610 200
Oil and Gas Inventory and Analysis	NSDME	NSDME	3	5	-	613 900
Publications	NSDME	NSDME/NSDOD	N/A	7	3	429 200
Resident Geologist's Office	NSDME	NSDME	N/A	15	-	266 000
Subsurface Investigations	NSDME	NSDME	N/A	4	4	605 200
Grants for Mineral Development (MISP)	-	-	N/A	-	1	125 500
TOTALS	-	-	**31**	**70**	**20**	**5 840 200**

NSDME = Nova Scotia Department of Mines and Energy
NSDOD = Nova Scotia Department of Development

PROVINCE: **NEWFOUNDLAND**
1988-1989

PROGRAMS	SURVEY RESEARCH AGENCY	FUNDING AGENCY	NO. OF PROJECTS (OR FACILITIES)	PERMANENT[1] SMY	CASUAL SMY	SALARIES			OPERATING EXPENDITURES $
						PERMANENT $	CONTRACT[1] $	CASUAL $	
Director's Office	NDME	NDME	4	8	2	184 898	42 768	7 239	97 208
Core Repositories	NDME	NDME	1	3	2	68 057	31 194	9 027	25 606
Geochemical Surveys:									
1) Bedrock	-	-	-	-	-	-	-	-	-
2) Drainage	NDME	NDME	5	6	1	135 470	52 543	876	64 948
3) Soil	-	-	-	-	-	-	-	-	-
Geological Surveys, Bedrock:									
1) Reconnaisance (1:100 000)	NDME	NDME/DEMR	8	10	7	202 181	100 162	43 011	266 326
2) Detailed (1:50 000)	NDME	NDME/DEMR	10	12	3	256 446	108 052	32 688	228 414
Geological Surveys, Surficial:									
1) Reconnaisance (1:100 000)	-	-	-	-	-	-	-	-	-
2) Detailed (1:50 000)	NDME	NDME	4	7	5	119 785	149 906	29 189	116 831
Geophysical Surveys:									
1) Airborne Electromagnetic	-	-	-	-	-	-	-	-	-
2) Airborne Magnetic	-	-	-	-	-	-	-	-	-
3) Ground Magnetic	NDME	NDME	1	1	1	-	36 662	6 401	35 055
4) Gravity	-	-	-	-	-	-	-	-	-
5) Seismic	-	-	-	-	-	-	-	-	-
6) Radiometric	-	-	-	-	-	-	-	-	-
Hydrogeological Surveys	-	-	-	-	-	-	-	-	-
Information and Education	NDME	NDME	7	11	-	177 375	120 202	-	254 052
Laboratory Analysis	NDME	NDME/DEMR	3	10	-	231 154	50 049	-	175 509
Mineral Deposit Inventory and Analysis	NDME	NDME/DEMR	12	18	3	202 777	279 922	21 682	225 648
Publications	NDME	NDME/DEMR	5	14	-	182 115	143 209	-	201 412
Resident Geologist's Office	-	-	-	-	-	-	-	-	-
Subsurface Investigations	-	-	-	-	-	-	-	-	-
Water Resource Inventory and Analysis	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-
TOTALS	-	-	60	100	24	1 760 258	1 114 669	150 113	1 691 009
GRAND TOTAL	***4 716 049***								

[1] Includes long term temporary staff
NDME - Newfoundland Department of Mines and Energy
DEMR - Department of Energy, Mines and Resources, Canada

PROVINCE: NORTHWEST TERRITORIES
1988-1989

PROGRAMS	SURVEY RESEARCH AGENCY	FUNDING AGENCY	NO. OF PROJECTS (OR FACILITIES)	PERMANENT SMY	CASUAL SMY	SALARIES PERMANENT $	SALARIES CASUAL/ TEMPORARY $	OPERATING EXPENDITURES $
Head Office (Administration, General Support)	INA	INA	1	4.7	0.2	250	16.3	135
Head Office (Administration, General Support)	MDA	MDA	1	-	0.8	-	34	80
Core Respositories	INA	INA	1	0.2	0.5	10	24	15
Geological Surveys:								
Bedrock (1:50000)	INA	INA	4	1.3	2.5	78	127	160
Bedrock (1:50000)	MDA	MDA	5	-	10		360	381
Surficial (1:50000)	INA	INA	2	0.1	0.3	6	20	35
Education	INA	INA	-	0.5	-	25	-	15
Education	MDA	MDA	-	-	-	-	-	76
Laboratory Analysis	INA	INA	-	0.1	-	3.0	-	12
Mineral Deposit Inventory and Analysis	INA	INA	2	-	1.8	-	-	76
Mineral Deposit Inventory and Analysis	MDA	MDA	2	-	2.0	-	80	60
Publications	INA	INA	12	3.0	0.7	190	50	30
Publications	MDA	MDA	1*	-	0.1	-	-	2
Other:								
Prospectors' Assistance	INA	INA	-	0.3	-	18	-	6
Geological Contracts	INA	INA	5	0.4	-	28	-	60
MDA Contracts	MDA	MDA	7	-	-	-	-	165
INA Totals	**INA**	-	**N/A**	**10.6**	**6.0**	**608**	**237.3**	**544**
MDA Totals	**MDA**	-	**N/A**		**12.9**		**474**	**764**
GRAND TOTALS	-	-	***N/A***	***10.6***	***18.9***	***608***	***711.3***	***1 308***
GSC managed Canada-NWT MDA Projects	**GSC**	**MDA**	**18**	-	-	-	-	**1 287**

INA – Indian and Northern Affairs, Canada*
MDA – Mineral Development Agreement (Canada-NWT Government)
N/A – Not Applicable
* – MDA preliminary reports were released in the INA open file system

PROVINCE: YUKON
1988-1989

PROGRAMS	SURVEY RESEARCH AGENCY	FUNDING AGENCY	NO. OF PROJECTS (OR FACILITIES)	PERMANENT SMY	CASUAL SMY	SALARIES		OPERATING EXPENDITURES $
						PERMANENT $	CASUAL/ TEMPORARY $	
Head Office (Administration, General Support)	INA	INA	1.0	2.5	-	136 000	-	95 600
Core Repositories	INA	INA	1.0	-	0.25	-	6 400	7 300
Geochemical Surveys								
1) Drainage	EMR INA	EMR/EDA INA	3.0	-	-	-	-	51 000
Geological Surveys Bedrock:								
1) Detailed (1:50 000)	INA	EDA	2.0	-	4.0	-	110 000	215 000
Geological Surveys, Surficial	INA	INA	1.0	0.5	0.25	35 000	8 500	3 400
Education	INA	INA	1.0	-	-	-	-	31 500
Laboratory Analysis	INA	INA/EDA	2.0	-	-	-	-	153 500
Mineral Deposit Inventory and Analysis	INA	INA	9.0	3.0	0.25	173 000	6 300	92 300
Publications	INA	INA	2.0	1.0	0.25	35 000	5 100	25 400
TOTALS	-	-	**23.0**	**7.0**	**5.0**	**379 000**	**136 300**	**999 400**

INA – Indian and Northern Affairs Canada
EDA – Canada–Yukon Economic Development Agreement
EMR – Energy, Mines and Resources Canada

GEOLOGICAL PROGRAM HIGHLIGHTS

PROVINCIAL AND TERRITORIAL GEOLOGICAL SURVEYS

1988–1989

BRITISH COLUMBIA MINISTRY OF ENERGY, MINES AND PETROLEUM
BRITISH COLUMBIA GEOLOGICAL SURVEY

During 1989, the British Columbia Geological Survey Branch carried out a record 30 detailed and regional-scale field programs, including 9 parties conducting systematic 1:50 000 regional mapping. The Branch also supported 25 research programs at universities for mapping and mineral deposit-focussed projects that complement the work. This was the last year of fieldwork under the 1985–1990 Canada–B.C. Mineral Development Agreement which supported nine projects. A new program in surficial geology was initiated in 1989. Despite a placer mining industry worth at least $50 million annually to the province, the Branch has not had a dedicated program in surficial geology since the late 1950s.

In 1989, the government of B.C. confirmed the recent expansions in the survey as part of the core program and most of the numerous contract positions were converted to full-time status.

PROGRAM HIGHLIGHTS 1989–90

Applied Geochemistry

The release, in late June, of Regional Geochemical Surveys 21, 22 and 23, which cover northern Vancouver Island and the adjacent mainland, was well attended by the exploration community.

Format modifications to map sheets, data booklets and the collection of moss mat sediment on Vancouver Island met with considerable favour, selling over 100 data sets the first day of release. The initial production run of 200 data sets was sold out by mid-September, requiring a second production run.

Sampling for the 1989 Regional Geochemical Survey (RGS) program continued with moss mat sediment on southern Vancouver Island and stream sediments on the lower mainland. Approximately 2430 samples have been collected at a density of 1 site per 10 km^2.

Orientation surveys were conducted in the southeastern Rocky Mountains, in an area covered by NTS map sheets 82 G, 82 J and 82 N. The results of geochemical sampling will be used to help define optimum sample media and geochemical patterns produced by the interaction of type mineral deposits with the various physiographic and climatic environment present in the study area.

Regional Mapping

The Geological Survey Branch initiated a systematic, regional, 1:50 000 scale, geological mapping program in 1985. This program, which began with 4 projects and 100 percent MDA funding, now consists of 10 mapping projects largely funded by the province. No new projects were initiated in 1989. Two projects, the Sicker and the Midway-Cassiar, were completed and are now in the write-up phase.

The MDA-funded Sicker Project, under Nick Massey, is in the final compilation stage after three years of fieldwork. A revised stratigraphic and structural framework has helped improve understanding of the metallogeny of the area, which is an important target for polymetallic massive sulphides and quartz-carbonate gold veins.

In the Bridge River area, Paul Schiarizza and Bob Gaba completed an MDA-funded mapping project that began east of Taseko Lakes in 1986. This year's program has contributed to a better understanding of the Bridge River complex, Shulaps ophiolite complex and Cadwallader Group, and the complex system of thrust, strike-slip and normal faults that juxtapose them. The discovery of significant molybdenite mineralization within the Eocene Mission Ridge pluton has provided explorationists with an important new metallotect.

Larry Diakow completed the last year of mapping for the MDA- funded Whitesail Project. The 1989 map area was centered on Morice Lake, an area of known porphyry copper and related vein deposits. The project has helped refine regional facies variations that can be used to locate Jurassic and Cretaceous volcanic centres that may be mineralized.

Joanne Nelson's four-year Midway–Cassiar Project is now in the write-up stage. New developments for 1989 include: evidence for a cryptic intrusion beneath the Erickson–Taurus gold-quartz vein system; a structural study of the Cassiar–McDame mine area by Dave O'Hanley that will "wed" regional- and mine-scale mapping; and an examination of placer gold sources and transport mechanisms, through field observations and gold microprobe analysis, by John Knight and Ken McTaggart at the University of British Columbia.

Pat Desjardins and Don MacIntyre completed mapping of the Telkwa Range, southwest of Smithers. The area has numerous vein and porphyry copper prospects that are related to Jurassic and Cretaceous plutons. Thick sections of ash flows and basalt characterize the type area for the Lower Jurassic Telkwa Formation, suggesting proximity to a major Jurassic volcanic center.

Filippo Ferri carried out additional mapping and geochemical sampling in the Germansen Landing area, where a series of carbonate hosted silver-lead-zinc showings are present. This mapping has further refined understanding of the structure and stratigraphy of a sedimentary wedge of Proterozoic to middle Paleozoic age rocks of North American affinity, and that of the middle to upper Paleozoic Slide Mountain Group. The latter appears to have formed in a marginal, oceanic basin. Jim Logan continued mapping and mineral assessment north of the Iskut River, in the Forrest Kerr map sheet area. Paleozoic "Stikine Assemblage" stratigraphy has been delineated and further subdivided, and indicates potential for volcanogenic massive sulphide deposits. Rocks similar to those hosting the Eskay Creek gold deposit are also present. Mapping has also shown that regional fault structures localize high-grade gold-bearing skarns and quartz veins which are the main exploration targets in the area.

The second year of the Stikine project, led by Derek Brown, concentrated on Mesozoic stratigraphy in the Stikine–Chutine rivers area. A Late Triassic orogeny is constrained by deformed Upper Triassic sediments unconformably overlain by flat-lying Lower Jurassic (?) volcanic rocks. A second regional unconformity is expressed by Late Cretaceous polymictic conglomerate that lies on an irregular erosional surface of Upper Triassic and Lower Jurassic rocks. Four plutonic episodes are defined from K-Ar geochronometry.

Mitch Mihalynuk completed a third season of mapping in the Tagish lakes area, which includes lithotectonic belts of Proterozoic to Paleozoic Nisling assemblage, Mesozoic Whitehorse Trough, and Cretaceous to Tertiary Coast plutonic rocks. This work has helped to refine stratigraphic and structural relationships within, and between, the major geologic packages, and to outline zones of high mineral potential. One fault-controlled vein system, discovered by the crew in 1988, was the focus of a drilling program in 1989.

Mary Anne Bloodgood continued mapping the Cache Creek terrane to the south of the Atlin Placer gold camp. Here, both placer gold and lode gold occurrences are spatially associated with altered ultramafic rocks within fault zones. The result of this work has been an increased understanding of the stratigraphic and structural setting of the Cache Creek Group rocks which host much of the lode gold mineralization. Exploration activity has focussed on the examination of major structures such as the Nahlin fault, along which lode gold occurrences have been documented.

Surficial Geology

In 1989, a Surficial Geology unit was created in the Geological Survey Branch. Their mandate covers the development of a gold placer data base, evaluation of surficial deposits, assessment of drift prospecting techniques and identification of geological hazards.

Field programs were initiated in the Wells–Barkerville, Quesnel, Hixon, Horsefly and Likely regions. Glacial overburden data, combined with historical information from placer miners, will be used to develop models of placer gold depositional environments.

Mineral Deposits

This program studies and models mineral districts, camps and deposits in the province and provides metallogenic summaries for the Canadian Cordillera.

Most projects have a gold or a combined base metal and gold focus. Two are in the write-up phase: Andre Panteleyev–gold and copper-gold deposits of the Quesnel trough; and Neil Church–gold deposits of the Bridge River Camp. Active (or ongoing) projects include work by: Dani Alldrick, who extended mapping westward from Sulphurets to include the Johnny Mountain and Snip gold deposits in northwestern B.C.'s "Golden Triangle"; Trygve Hoy expanded his study of copper-gold and gold potential in the Rossland volcanic rocks; and Gerry Ray initiated a new study of skarn deposits in the Insular belt.

Metallogenic studies of mafic and ultramafic rocks expanded. Graham Nixon completed MDA-funded work on B.C.'s Alaskan ultramafic complexes and Chris Ash began a project to evaluate the structural and economic significance of listwanite (quartz-carbonate) alteration in the Atlin and Cassiar camps and along the Pinchi fault near Fort St. James.

Tom Schroeter visited many sites of major exploration activity and updated the compilation and map of gold deposits in British Columbia.

W.J. McMillan managed the section, carried out metallogenic and geochemical analyses, and presented material at a workshop set up by the Mineral Deposits Division of the Geological Association of Canada in response to renewed interest in porphyry copper deposits.

Industrial Minerals

In 1989, the Industrial Minerals Program concentrated on completing field projects with comprehensive final reports. Geotex Consultants completed the report on the industrial minerals potential of Tertiary Basins between Princeton and the Chilcotin River, and J. Pell updated her manuscript on carbonatites and ultra-alkalic rocks with new data from the Kechika River area. Final reports on phosphates and gypsum by S. Butrenchuk and on fluorspar by J. Pell were prepared for publication. Three compilation studies were completed: a barite resource inventory, by S. Butrenchuk; a limestone and dolomite inventory, by P. Fischl; and a study of chromite potential, by K. Hancock. G. White completed the field assessment of perlite and vermiculite occurrences, and V. Marcille continued her MSc research on horticulture applications of British Columbia zeolites and phosphates, at the University of Guelph.

Coal Resources

Most members of the Coal Subsection conducted field programs during the 1989 season. All producing mines were sampled to supplement our coal quality studies (D. Grieve and B. Van Den Bussche). Work continued on Vancouver Island with mapping in the Comox basin (C. Kenyon and C. Bickford). Mapping was completed in the Tumbler Ridge area, with bulletin production scheduled for next year (W. Kilby and J. Hunter). Our subsurface sampling program of small diameter diamond drilling moved to Telkwa, after a successful program at Quinsam in 1988 (A. Matheson). This season the Geological Survey of Canada participated on an equal-funding basis, and strong industry interest was shown in the methodology. The potential of the upper Cretaceous coal measures of northeastern B.C. was examined (B. Ryan and H. Kucera). The stratigraphy and quality of the Telkwa deposit was examined under contract by R.M.B. Earth Science Consultants Ltd. This study will lead to an MSc thesis at the University of British Columbia, by R. Palgrove.

Coal petrography studies continued with the acquisition of an image analysis system and near completion of a three-axis computer-controlled microscope stage assembly.

Our brochure summarizing B.C. coal quality and specifications has gone through several printings; the more detailed "Coal Quality Catalogue" will soon be released, as will a thermal coal availability study. Interest in "coalbed methane" has increased sharply over the last year. Several of the subsection's projects are now including evaluation of this resource in their objectives.

Land Use

Fieldwork in the Land Use Program is directed at defining the mineral potential of candidate park areas that could ultimately be alienated from exploration and mining activities. In 1989, Graeme McLaren completed the first year of a mineral resource assessment of the Purcell Wilderness Conservancy. This area is underlain by Purcell Supergroup stratigraphy, including the Aldridge Formation that hosts the Sullivan Mine. Lead-zinc-barite vein mineralization in the upper Purcell strata appears related to tight recumbent folding and thrust faulting. A detailed stream sediment geochemical survey was conducted over half of the study area this year.

The subsection was strengthened in 1989 with the addition of a second geologist, Rolf Schmitt, who undertook planning for a future study of the Skagit and Cascades recreation areas.

District Geologists

In 1989, the responsibilities of the five District Geologists continued to be: providing timely and informed advice to the ministry's Mines Development Review Process; maintaining an up-to-date inventory of the geology, exploration trends and developments throughout the province; providing advice to industry, prospectors and the public; and providing training for prospectors.

Although exploration activity is appreciably lower than the record levels attained in 1987 and 1988, the District Geologists continued to carry out field studies in several "hot" areas such as the Omineca Belt, the Iskut gold belt, the North Coast, the Okanagan, various parts of Vancouver Island, and the Kootenays.

Financial Assistance for Mineral Exploration (FAME)

The Fame program was renewed for the 1989–90 fiscal year with support for the Prospectors Assistance Program. The $500 000 funding is used to promote prospecting activity by providing training, and financial and technical assistance to prospectors.

The program supports two training courses and contributes to several others. The 13th annual Advanced Prospecting Course was delivered April 24 through May 11, 1989, to a class of 31 students. The course, already recognized as one of the best in Canada, promises to be even better in 1990 with an improved content.

Eighty-four grants, up to a maximum of $7500 per prospector, were awarded in 1989–90 to independent prospectors to help them in their search for the mines of tomorrow. In addition to financial assistance, free advice and consultation in the field are offered to prospectors by Ministry personnel active throughout the province.

Geoscience Research

The branch's Geoscience Research Grant Program was continued and expanded in 1988. Twenty-seven grants, totalling $130 000 were awarded to individuals at 15 universities, in support of research on the geology and mineral deposits of the province. In addition, the MDA contributed $60 000 to The University of British Columbia in support of 11 research projects. Results of these research programs are published in "Geological Fieldwork".

ALBERTA GEOLOGICAL SURVEY

The Alberta Geological Survey Program is carried out by the Alberta Geological Survey and Terrain Sciences departments of the Alberta Research Council, a Crown corporation of the government of Alberta. Our mission is to supply the geoscience information needed by government for land use planning, resource management, and policy development, and by industry for environmentally responsible resource exploration and development. During 1989, activities covered five main areas: petroleum geology and basin analysis, coal geology, industrial and metallic minerals, oil sands geology, and geoscience information systems. Most of the work was jointly funded with government departments and agencies, with the remainder done under contract to industry or government or funded internally.

OIL SANDS GEOLOGY

Geological support for the Alberta Oil Sands Technology Research Authority (AOSTRA) underground test facility (UTF) was the main priority in 1988/89 for the Strategic Research Program program funded entirely by AOSTRA. Documentation of the UTF geologic framework is fundamental to developing and refining the new technology used at the UTF site. Activities range from detailed core work to mapping, calculating reserves, and planning drilling programs for UTF expansion. Oil Sands Geology studies consist of two research programs. The largest, the Joint Oil Sands Geology program, is funded equally by the Alberta Research Council, the Alberta Department of Energy, and AOSTRA. Resource characterization of Athabasca Central and Athabasca South provide the framework for oil sands development in these areas.

In reservoir analysis, the scaling up of values for reservoir parameters, such as permeability, from core to reservoir grid scale, continued with the use of numerical and three-dimensional physical flow models. Project results show that reservoir pore systems are strongly related to lithofacies and that heterogeneities affect fluid flow in the reservoir.

COAL GEOLOGY

The Coal Geology Group, jointly funded by the Alberta Department of Energy and the Alberta Research Council, completed a three-year study of the distribution of coal quality parameters of Alberta coals. Detailed coal facies and statistical studies in the plains, and sedimentology and structural studies in the mountains/foothills have been completed. This work is putting coal quality data in a geological framework and creating models that can be used to predict coal quality variations. The program has been extended for another year.

A user-friendly, efficient digital database has been created and a demonstration of Geographic Information System (GIS) applications to geology has been prepared. New regional mapping initiatives in the outer foothills between Grande Cache and Hinton, and in the Coalspur area were added to the database and GIS.

PETROLEUM GEOLOGY AND BASIN ANALYSIS

The study of the Peace River Arch area in Alberta and British Columbia is a cooperative effort between the Alberta Geological Survey and the Institute of Sedimentary and Petroleum Geology in Calgary. This is the final year of a three year program aimed at understanding the relationship between this geological structure and hydrocarbon accumulations. During 1989 the project completed geological studies of 4 groups of formations as well as implemented basin evolution and hydrocarbon accumulation models.

Work continued on the Geological Atlas of the Western Canada Sedimentary Basin. This project coordinates the work of more than 150 volunteers from industry, academia and government organizations. The Atlas will provide a more sophisticated geological framework needed to find and exploit oil and gas in a basin at a mature stage of development.

A hydrogeology study to investigate a possible link between geopressure and hydrocarbon occurrences in the Beaufort–Mackenzie Basin was completed.

A study on the long-term prediction of pressure buildup at the Swan Hills deep injection well of the Alberta Special Waste Management Corporation was carried out.

INDUSTRIAL AND METALLIC MINERALS

Under contract to Alberta Forestry, Lands and Wildlife, the Alberta Geological Survey is investigating possible economic occurrences of an extensive array of minerals essential as raw materials in pulp and paper production. Of the twenty or so minerals going into this industry, the critical ones are salt, sulphur, and limestone and studies show that Alberta has substantial reserves of these minerals.

In anticipation of renewed interest by industry in exploring Alberta's potential for metallics, the Alberta Department of Energy commissioned the Alberta Geological Survey to compile and conduct a preliminary assessment of the metallogenic database for northeast Alberta. This information will provide a basis for formulating exploration strategies for the Shield area and determine where research effort can be applied most effectively. A reconnaissance study of gold and other placer minerals in Tertiary gravel deposits of Alberta was advanced in 1989. Fieldwork and data gathering were completed on many of the major deposits and indicate significant resource potential for recovery of these minerals as a by-product. Continued work on aggregate resource studies focused on the Municipal District of Provost and the Spirit River Forest sub-region, where new sources of gravel are needed to replace depleted supplies.

QUATERNARY AND ENVIRONMENTAL GEOLOGY

The Terrain Sciences Department (TSD) includes a multidisciplinary team of people with expertise in Quaternary and surficial geology, glaciotectonic terrain, coal mine reclamation, hydrogeology, soil science, erosion, drilling waste disposal, geographic information systems, digital modelling, and simulation modelling. Research by the applied geology land reclamation and environmental hydrogeology groups of TSD complements that of the Alberta Geological Survey. Recent contributions have focused on the highwall stability problems of coal mines; the recognition, structure, and distribution of glacially thrust bedrock; the application of surface and downhole geophysical techniques for plains coal mining; mine reclamation; small- and medium-scale surficial mapping; and the development of the Quaternary stratigraphic and hydrostratigraphic framework in the Cold Lake oil sands and Lloydminster heavy oil areas.

INTERNATIONAL ACTIVITIES

John Kramers was responsible for resource delineation of a bitumen deposit in Indonesia through an ARC contract with the Indonesian government. At the request of AOSTRA and MINBAS (Cuban Ministry of Basic Industries), Brian Rottenfusser evaluated the state of geological knowledge and development potential of several bitumen deposits in Cuba. Jan Boon and Daryl Wightman participated in a scientific exchange program with the Research Institute of Petroleum Exploration and Development of the China Petroleum Corporation.

SASKATCHEWAN DEPARTMENT OF ENERGY AND MINES
GEOLOGY AND MINES DIVISION

The geoscience activities of the Geology and Mines Division, commonly called the Saskatchewan Geological Survey, are undertaken by four branches: Precambrian Geology, Mineral Development, Petroleum Geology and Sedimentary Geodata. Advice and evaluation on program content are provided by the Saskatchewan Geological Liaison Committee, made up of representatives from industry, universities and the Saskatchewan Research Council. Geoscience results are presented annually at the Saskatchewan Geological Survey Open House held in November, along with the release of the annual "Summary of Investigations" report.

1988-89 PROGRAM

Geoscience projects in the Precambrian Shield region were funded in the past five years under the Canada–Saskatchewan Mineral Development Agreement (MDA) 1984–89, aimed principally at stimulating and assisting the mineral exploration industry in exploration for gold and precious metals in northern Saskatchewan. The total program budget was approximately $6.3 million, split 50:50 on a parallel delivery basis between the federal and provincial governments. Provincial funds are supplemented, where possible, by co-operative projects with other agencies, mainly universities.

Expenditures in 1988–89 were restored to approximately $0.69 million, up from the previous year's $0.46 million, by means of a Summer Student Employment Program. In 1988–89, the federal component of the MDA, managed by the Geological Survey of Canada (GSC), was confined essentially to writing up project results from the first four years of the program.

Precambrian Geology

In the first four years of the MDA, the province largely concentrated on remapping the bedrock of the La Ronge gold belt at 1:20 000 scale. A number of gold mines are being developed in this area, situated northeast of La Ronge. Work continues on the preparation of final reports and compiled maps, at 1:50 000 scale, from this mapping as well as on lithogeochemical studies at the University of Regina. In 1988–89, in response to indicated mineral occurrences, Precambrian projects diversified into other regions.

The "Glennie Transect" was designed to scan a cross section of potentially mineralized greenstone belts in the southern part of the Glennie Domain. The project is multidisciplinary in nature, focussing around three 1:20 000 scale bedrock remapping parties and ancillary geochemical, mineralogical, metamorphic and structural geology studies carried out by university contractors and joint-project researchers. In the Brownell Lake area, a number of existing and subsequently discovered gold showings have been related to high-strain zones.

Investigations in the Mudjatik Domain followed the discovery, by industry, of a new occurrence in the Ithingo Lake area where gold occurs in quartz veins hosted in sheared gneisses. This is a granulite-facies setting and a new type of environment for gold mineralization.

The "Snowbird Transect", initiated in 1988, is a joint venture with the University of Kansas, the University of California at Santa Cruz and the University of Regina involving bedrock mapping by graduate students with emphasis on geochemistry and isotopic studies. Funding for the field costs involved in this work comes from the Saskatchewan Geological Survey; funding for the geochemistry and isotopic studies comes from the US participants. This program is aimed at examining critical junctions between major geological domains, including an anorthosite environment possibly favourable to platinum group element (PGE) mineralization.

Several new U-Pb zircon dates, mainly for rocks from the Mudjatik, Peter Lake and Glennie domains, were produced during the year through the joint-venture geochronology program with the University of Kansas. A PhD student working under this program identified two Archean windows in the Glennie Lake area.

A number of regional Precambrian geoscience data bases have been developed on microcomputer in recent years. These include the Precambrian Bibliography, Geochronology and Lexicon data bases. Coloured compilation bedrock geology maps at 1:250 000 scale now cover over 65 percent of the Precambrian Shield area in first edition, and work continues on the production of these maps.

Mineral Development

Gold deposit investigations continued in the Sulphide Lake area, north of La Ronge, and a new project was initiated at the historic Box and Athona gold mines at Goldfields, south of Uranium City. Both of these areas are being explored by industry. Project investigations also continued in the Goldfields area on a newly recognized type of polymetallic U-Au-PGE deposit. A project in the Peter Lake area mapped intrusions for their rare earth element (REE) potential. A study of Wollaston group stratigraphy in relation to uranium deposits of the Athabasca Basin was contracted to the Saskatchewan Research Council.

A measure of the extent of mineral exploration activity in the north is provided by the 1634 submissions received for claimed expenditures of $31.7 million (up 1 percent from 1987–88). A total of 266 new mineral exploration assessment files were incorporated into the historical record; 144 visitors were received and 129 requests for information handled.

Computerization of the Saskatchewan Mineral Deposits Inventory continued and various software options were evaluated. New occurrences were documented and data from 2140 identified deposits are now on file.

Both Resident Geologists are now headquartered in La Ronge, leaving the Creighton office operational on a part-time basis. Over 1250 visitors were received at the Resident Geologists' offices.

The Mineralized Core Collection in La Ronge received 2654 m of core from uranium deposits in the Athabasca Basin and from gold and base metal deposits in the La Ronge and Flin Flon regions. Some 44 people examined core from the collection during the fiscal year.

The Prospectors' School offered a six-week course to students primarily from northern communities, from which 17 students graduated. Funding for most students was provided under the Canada–Saskatchewan Northern Employment Development Subsidiary Agreement.

Two new sheets of the 1:250 000 scale metallogenic map series were released in 1988–89 and two others are in edit.

Petroleum Geology

Stratigraphic information from 1873 licensed wells was added to the Well Information System (down from 2035 in 1987–88).

Three major projects continued: 1) the geology of the Medicine Hat Sand (Cretaceous) in southeast Saskatchewan, 2) development of a depositional model for the oil-prone Jurassic section in the Wapella–Moosomin area, southeast Saskatchewan, and 3) the geology of the Interlake Group (Silurian).

Three smaller projects were undertaken as contributions to the new "Geological Atlas of Western Canada". Six professional papers were presented and/or published. Numerous consultations were given to industry geologists. Several workshops on introductory geology were arranged for school groups.

Sedimentary Geodata

The Sedimentary Geodata Branch deals with industrial minerals, the Well Information System, and (Phanerozoic) geophysical records. Industrial mineral projects included:

1. contributions to a joint federal-provincial project for determining recoverable coal reserves in the Estevan area

2. sampling and analysis of kaolinized sand deposits in the Rural Municipality of Brokenshell

3. investigations of the significance of carnallite and de-carnallitization of the Prairie Formation in subsidence over Winnipegosis banks in Saskatchewan and the accumulation of brines in overlying formations

4. background investigations relating to the feasibility of commercial industrial brine accumulations and the application of waste carbon dioxide in the alteration of brines to useful value-added commodities such as soda ash and gypsum

5. field investigation of eight bodies of Precambrian plutons in the Missinipe–McLennan Lake area for building stone potential

A total of 153 major inquiries on technical aspects of industrial minerals were handled. Work continued on the computerization of the geophysical map and report files. Data submissions by industry under the Well Information System totalled 11 401; 28 339 photocopies were made for industry and 1870 new files were set up.

1989–90 PROGRAM TO AUGUST 31 1989

With the conclusion of the MDA on March 31, 1989, and pending a successor MDA, the province has funded a new geoscience program, the Mineral Industry Diversification Program (MIDP). This program has a broader coverage than the MDA, but the emphasis is still predominantly in the north.

Base metals now join gold as commodities of interest to the exploration industry in northern Saskatchewan. The completion of the airborne gradiometric survey over the eastern part of the Shield edge east of Limestone Lake (under the recent MDA), and the recent major discovery by Trimin–Cameco at McIlvenna Bay, Hanson Lake has drawn attention to the potential for base metals in that region, particularly under the thin Paleozoic cover. The program has been arranged across organizational boundaries. The following sections update field-oriented projects mounted in the summer of 1989, mainly under the MIDP (core headquarter-based activities are not included).

Reconnaissance Bedrock Geology

The bedrock geology of about 15 600 km^2 in northern Saskatchewan still remains unmapped, apart from some early 1:15 840 scale reconnaissance by the GSC. In the summer of 1989, 1:100 000 scale reconnaissance mapping was resumed, after a gap of several years, in the extreme northeastern quadrant of the province.

Gold Belt Geology

Two field parties continued 1:20 000 bedrock remapping in the southern part of the Glennie Domain, with particular interest in the identification of high-strain zones and gold mineralization. The multidisciplinary approach is maintained through associated lithogeochemical, metamorphic and geochronological studies.

Gold deposit structural studies in the La Ronge belt have demonstrated the importance of strike-slip movements in controlling gold-quartz vein emplacement.

Stable and radiogenic isotope investigations at the University of Saskatchewan are focussing on polymetallic U-Au-PGE and related deposits in the Goldfields-Beaverlodge area north of Lake Athabasca, to determine the nature and age of the mineralizing fluids.

Metallic Minerals Diversification

The primary objective of this group of projects is to renew interest in base metals and other commodities.

Remapping of bedrock with supporting lithogeochemical studies were initiated in the Flin Flon Domain, in a program which is expected to continue over the next few years.

Re-evaluation studies in the Hanson Lake Block have revealed the presence of extensive ductile shear fabrics with contemporaneous anatexis and plutonic, rather than supracrustal, protoliths.

A small area surrounding the historic Western Nuclear Pb-Zn deposit was geologically mapped at 1:20 000 scale and selected cores from the newly discovered McIlvenna Bay deposit nearby were logged.

Beryliferous granite pegmatites in the Sturgeon–Weir River and Hanson Lake areas were examined and sampled.

Investigation of low-grade granite-hosted gold mineralization at the Box and Athona mines and the Frontier prospect, in the Goldfields area north of Lake Athabasca, supports the proposed origin of the deposits from granitization. In this model low-viscosity injected granite magma was accompanied by diffuse fluids which permeated and granitized the host rocks, with the coevel introduction of gold.

A joint project with industry and the Saskatchewan Research Council is establishing a more detailed stratigraphy of the Wollaston Group. The 1989 summer's work indicated that some Wollaston Group meta-arkoses may be mylonitized Archean basement.

A study of the Raven–Horseshoe uranium deposit is being undertaken jointly with the Saskatchewan Research Council and Cameco. Preliminary findings indicate similarities with other basement-hosted unconformity-type uranium deposits.

Mapping at 1:20 000 scale was continued, in 1989, by the students involved in the Snowbird Transect, in the western part of the Shield.

Petroleum Geology

Petroleum Geology projects are largely being conducted outside the MIDP. The following projects are reported in the Summary of Investigations, 1989.

1. The Earlie Formation (Cambrian) in Saskatchewan

2. Geology and natural gas production of the Upper Cretaceous Medicine Hat Group, southwest Saskatchewan

3. Distribution of Lower Paleozoic Strata in the vicinity of the Meadow Lake Escarpment, west-central Saskatchewan

4. Palynology of the Shaunavon and Gravelbourg formations of southern Saskatchewan

5. Pore geometry reservoir model for the carbonate buildups in the Winnepegosis Formation (Devonian) in southeast Saskatchewan (University of Regina contract)

6. Sedimentology and geochemistry of the Bakken Formation (Devonian-Mississippian) in southern Saskatchewan (University of Regina contract)

Industrial Minerals

There are presently five projects studying the geology of industrial minerals in Saskatchewan.

1. Building Stone Investigations—a number of prospective sites in the Precambrian and Ordovician of the east-central region are being identified as a source for building stone.

2. "Project OWL"—investigation of the stratigraphy and mineral potential of the sub-ephemeral shallow Old Wives Lake in southern Saskatchewan.

3. Industrial Minerals Market Feasibility Study—this project evaluates a range of structural industrial minerals in the southern part of the province.

4. Subsurface Brines Study—this project studies the economic potential of brines emanating from Devonian strata in the south.

5. Prairie Evaporite Study—this project examines the complex interrelationships of gypsum, anhydrite, carnallite, sylvite and limestone; and the diagenetic processes and volume reduction leading to the preservation of sylvite and carnallite.

Kimberlite (Diamond) Studies

The new excitement in Saskatchewan geology is the diamond exploration play centred around Prince Albert and farther afield. A program of kimberlite-oriented studies was initiated this year under the MIDP.

Further Sm-Nd studies of the Sub-Phanerozoic Precambrian basement in southern Saskatchewan are being conducted by the University of California at Santa Cruz, and the University of Regina.

Regional Phanerozoic anomalies are being studied, and well, geophysical and other data are being compiled to identify anomalies which may be related to the occurrence of kimberlite bodies.

Aerial photographs and remote sensing will be used in an attempt to classify and interpret linear and other features possibly related to kimberlite bodies.

Biogeochemical investigations over the environs of the Monopros–Sturgeon Lake kimberlite body are being conducted by the GSC in a joint program.

Public Information and Computerization

A major thrust of this group of activities is upgrading and extension of microcomputer data bases, and a geographic information system (GIS) feasibility review.

GEOSCIENCE ACTIVITIES
SASKATCHEWAN RESEARCH COUNCIL

Mineral Deposit Studies

The program has been oriented toward aspects of uranium exploration and development. A two-year study has begun to enhance the understanding of the Wollaston Group Stratigraphy. The chlorite-dravite trend is being investigated in the Athabasca Formation. A study is underway to characterize the background geochemistry and mineralogy of the Raven–Horseshoe deposit.

A project is being completed to characterize the major and minor element lithogeochemistry of the Martin Formation in the Beaverlodge area, in cooperation with the University of Saskatchewan and the Saskatchewan Geological Survey.

A project is being completed to characterize felsic instrusions in the Waddy Lake area in order to determine the relationship between the gold mineralization and the intrusions.

In the future, research will be focused toward investigating host-rock alteration associated with base metal deposits in order to develop metallogenic models as exploration tools to enhance mineral exploration.

Geochemical Services

The Geochemical Services Laboratory provides major and minor element analyses of ores, rocks, tills, soils, lake sediments and vegetation for both in house projects and the mineral exploration industry. Approximately 500 000 element determinations were performed on 50 000 samples during the past year, about 60% higher than the previous year. The heavy mineral concentrating facility is being well utilized by the exploration industry. A fire assay service is in operation for gold and platinum group elements. Instruments and techniques for separating and analyzing specific heavy minerals is being developed in response to the exploration activity for diamonds in southern Saskatchewan.

Mineralogical Services

A laboratory is operating for mineralogical analyses particularly identification of minerals by X-ray Diffraction analyses. The results of these analyses permit the detection of hydrothermal alteration associated with uranium mineralization in deep drilling across the Athabasca Basin. This mineralogical determination is also used for mineral identification in many other materials such as the clay minerals and alteration products in clay liners.

Drift Prospecting Studies

Quaternary geology mapping and sampling in areas of gold and platinum exploration is continuing in order to provide information about the glacial geology conditions and deposits to assist in the design, execution and interpretation of till geochemistry surveys. A report on work completed in the Amisk Lake area near Flin Flon was completed. Several contract studies are being carried out for various exploration companies.

Research is being conducted concerning mineral exploration in southern Saskatchewan in relation to prospecting for diamonds, placer gold and various industrial minerals.

The 1:250 000 scale National Topographic Series maps summarizing the surficial geology of the entire province are available and the production of a 1:1 000 000 scale Quaternary geology map of the province is underway.

Industrial Minerals Assessments

The compilation and assessment of aggregate resources for rural municipalities was continued. Aggregate assessments were completed for eight rural municipalities. The work was funded under the Canada–Saskatchewan Mineral Development Agreement, and the Department of Rural Development.

An assessment of the industrial mineral resources and market potential was begun this year. The purpose of this years work is to define structural minerals specifically and determine the availability and requirements for these types of mineral resources.

Groundwater Studies

An investigation of groundwater processes continued near Saskatoon, with emphasis on flow in tills, age dating, aquifer hydraulics and chemical processes. Graduate students from the University of Waterloo are assisting with the project. An investigation of computer assisted methods for producing geology and groundwater maps, cross sections and graphs is continuing.

An evaluation of the groundwater resources of the Regina area was completed and similar investigations for the area around Yorkton and Estevan were initiated under contract. Providing information on groundwater conditions along with monitoring of groundwater levels at 50 sites was continued. Monitoring subsurface brine migration at a Saskatchewan potash mine waste disposal facility continued. This work will be expanded to encompass investigating decommissioning options for the potash tailings piles and brine ponds.

Mineral Processing Activities

Mineral resources projects undertaken for clients include: ceramic whiteware and kaolin purification work, gold ore processing, and processing of mine tailings.

Pipeline Technology

The Pipeline Development Centre undertook projects for clients studying the transport of coal in crude oil, water-oil emulsions, tar sands and coal condensate slurries. Physical modelling of horizontal wells was begun this year in conjunction with other heavy oil research work.

Petroleum Research

Research projects focused on enhanced oil recovery, including steam injection, horizontal wells, in situ combustion and carbon dioxide injection. An enhanced light oil recovery project (carbon dioxide injection) is also underway. Other work includes emulsion treating, upgrading and alternative fuel products.

Spacial Information Services

The development of remote sensing, image analysis, computer mapping and GIS capabilities and methodologies for enhancing and interpreting exploration data is continuing. These techniques will be applied to assist mineral exploration through contracts with the mineral industry. Mapping and analyzing lineaments is one of the projects designed for mineral exploration.

Rock Mechanics

The triaxial testing of large potash cores to determine material properties has been completed successfully. A two year project to test 30 potash cores from Saskatchewan mines is underway. Rock mechanics instrumentation designed for and fabricated for potash mines includes: stress cells, closure meters, gauge panels, water pressure monitoring devices and data acquisition systems.

MANITOBA DEPARTMENT OF MINES AND ENERGY
GEOLOGICAL SERVICES BRANCH

During 1989, the operations of the provincial Geological Services Branch (GSB) were primarily geared to report and map production stemming from the previous five years of field surveys mounted under the Canada–Manitoba Mineral Development Agreement (MDA). Numerous publications were issued throughout the year, including several new additions to the Mineral Deposit series of reports.

The MDA process of developing an annual workplan covering survey activities for the upcoming year was repeated in the spring of 1989, along with distribution of this workplan to members of the Mineral Exploration Liaison Committee for critical review. Briefing sessions were again held in Winnipeg and northern centres to give explorationists in the regions an outline of the federal and provincial programs intended for the summer. An annual progress report for Sector "A" geoscientific activities conducted during 1988 and 1989 was released in June 1989.

The provincial GSB mounted 22 MDA projects, 11 of which entailed field components of generally limited duration (Figure 1). Fourteen new projects were also initiated as follow-up to the ongoing survey program in the province, and 10 of these involved an active field commitment. Student hiring was restricted to 17, and many of these were constrained to Winnipeg in support of data organization and processing.

Provincial operational budgets were set at $377.7K (MDA), and $379.4K (A-base).

Federal contributions (MDA and A-base) were limited to five field projects with an overall MDA budgetary allocation of approximately $163K. Most of the GSC personnel engaged in MDA projects during the 1984–1989 period were also committed to report and map production stemming from the earlier field projects.

A radiometric survey of the Ruttan–Eden lakes area, originally proposed for July, was postponed due to forest fires and rescheduled to October.

The RADARSAT office of the Canadian Centre for Remote Sensing undertook a Synthetic Aperture Radar survey of the Grand Rapids Uplands as part of a joint federal-provincial evaluation of this technology.

DISTRICT SUMMARIES

Lynn Lake–Leaf Rapids

A ground scintillometer reconnaissance survey of the Eden Lake monzonite confirmed the unique chemistry of the intrusion, as well as the existence of elevated levels of rare earth elements (REE) and uranium in discrete but narrow zones.

A section of the Main zone of the MacLellan Au-Ag deposit was mapped in detail and correlated with diamond-drill hole and surface observations. The study resulted in the recognition of four main vein sets, each associated with a unique alteration assemblage. Gold occurs within quartz-arsenopyrite veins formed towards the end stages of the latest ductile deformation, with minor remobilization associated with subsequent faulting.

An examination of the Johnson shear zone, the second metallotect in the region, concentrated on the Finlay, McKinlay and Prospector veins. A structural analysis of the veins concluded that the gold precipitation was a late event, occurring after the early ductile deformation and before brittle deformation associated with uplift.

Flin Flon–Snow Lake

Detailed mapping in the Tartan Lake–Embury Lake region completed coverage to the Saskatchewan border. At least three phases of faulting are recognized, the major block-bounding faults possibly being relatively early high-level faults with later reactivation. The recognition of extensive cross-faulting, especially in the Manistikwan block, may have played a significant role in developing structures and favorable environments for ore deposition.

Detailed mapping in the Chisel Lake area is attempting to clarify the relationships between the base metal deposits in this region and their associated stratigraphic footwall alteration zones. The recent work has demonstrated that, although base metal deposits in the Snow Lake area share several attributes in common with those at Flin Flon (association with volcanic rocks characterized by an island arc chemistry, spatial association with fractionated volcanic rocks, and same stratigraphic position as major rhyolite complexes), the Chisel, Lost and Ghost deposits also have an association with synvolcanic plutons, large semiconformable footwall alteration zones and volumetrically significant synvolcanic dyke complexes.

A two-week program of confirmational and infill mapping, and sampling for whole-rock geochemistry and U/Pb geochronology, was conducted in the Athapapuskow Lake area as the final phase of a multiyear detailed mapping program in this region.

No new field work was conducted in the Kississing Lake area, efforts being directed toward completion of reports and maps stemming from the last five years detailed mapping and investigations.

Regional overburden sampling in the Kississing Lake area provided additional information on geochemical anomalies in the area, as well as local and regional background values for till geochemistry in the Kisseynew domain.

Documentation of mineralization and associated alteration zones in the Snow Lake area, and around the Pulver and Herblet Lake gneiss domes, has continued since 1984. Several new exploration targets are proposed as a result of the more recent work, which highlights the significance of garnetiferous alteration zones as a potential host to base metal mineralization.

A geochemical study of the alteration zone associated with the North Cook Lake massive sulphide deposit demonstrated the presence of major, trace element and mineralogical anomalies centred on the deposit, including Cu and Au haloes for about 85 m on either side of the mineralization. More restricted Sb and Pb anomalies are associated with the occurrence of near-solid and solid sulphides, and the deposit appears to coincide with a trough in the Mn content.

Twenty-six mineral occurrences in the Batty, Limestone Point and Moody Lake areas were examined and described as part of the ongoing program of deposit documentation in the Churchill Province. Three weeks were also spent in investigating the structure and geology of the workings in the Puffy Lake gold mine.

As a follow-up to detailed geological mapping of the Baker–Patton felsic complex, drill core from the Cabin zone was sampled and logged. Previous interpretations regarding displacement of the ore-zone by faulting appear to be valid, and identification of a tuffaceous marker unit should help future exploration efforts in the area.

An important contribution was made in the Kisseynew Lake region by a mapping program that bridged the provincial border with Saskatchewan, providing correlation of units throughout this structurally complex zone. High-grade Amisk rocks were identified well to the north of previously recognized occurrences, supporting the contention that the Amisk volcanic rocks were caught up in the tectonic events that affected the main Kisseynew gneissic belt. A more contentious recommendation arising from this study proposes extension of the term "Amisk wackes" to all greywacke-derived paragneisses in the Kississing Lake region.

Southeast Manitoba

The inventory of mineral occurrences in the Bissett region is now complete, and the report in an advanced stage of production.

Thompson–Cross Lake

Detailed documentation of key sections in the Pipe II open pit mine is helping to redefine, and give diagnostic lithological, geochemical, magnetic and petrographic signatures to supracrustal units in the Ospwagan Group. This comprehensive definition of stratigraphic sequences in the Thompson region will play an important role in supporting future exploration for stratabound mineralization.

In the Cross Lake region, fieldwork was related to checking conflicts of interpretation stemming from geochronological studies by D. Davis of the Royal Ontario Museum, and a thesis study by M. Breedveld of the Free University of Amsterdam on the thermo-tectonic evolution of the supracrustal belt.

The shoreline of the east channel of the Nelson River, between High Hill Falls and Sugar Falls, was mapped in order to complete regional coverage for this NTS map sheet and to set a regional environment for the detailed investigations of the Cross Lake belt to the north. South of the Pipestone Lake anorthositic complex, numerous granitoid rocks are intensely sheared in a 1.5 km wide belt along the northern margin of the Molson Lake domain.

MANITOBA

In the past, numerous different approaches have been used to evaluate the potential for Mississippi Valley-type (MVT) lead and zinc deposits in the province's Paleozoic formations. This year attention switched to the northern Interlake region where abundant exposures of Silurian and Ordovician dolomites provide an ideal target for karst investigations, as well as geochemical investigations of groundwater. Sampling programs focussed on creek waters and sediments along the northwest shore of Lake Winnipeg, as well as waters and sediments from the springs emerging from the base of the Silurian escarpment.

The appraisal of karst features in Manitoba's Interlake continued in co-operation with contributions from the University of Winnipeg and the Speleological Society of Manitoba. The total number of caves now reported exceeds 100 and a significant number have been mapped, providing valuable information on the factors controlling the movement and behaviour of ancient and modern groundwater in this region. Of particular significance was the discovery of numerous caves and a unique "Cockpit Karst" topography in parts of the Gypsumville region.

An extensive drilling program was conducted in various sectors of the province to provide key information on various aspects of Manitoba's industrial minerals as well as stratigraphic data to correlate Silurian and Ordovician sequences between the northern and southern Interlake. Drill core from five holes north of Grand Rapids will also be analyzed for base metals as part of the MVT appraisal.

Other holes were drilled to evaluate high-silica sands at Manigotagan, Devonian reef structures at Swan Lake, building stone at Cross Lake, and chromite in an ultramafic body on Pipestone Lake.

Industrial mineral investigations focussed on the Swan River–Mafeking area, and on upgrading the maps of high-calcium limestone in the Dawson Bay–Point Wilkins region.

In southern Manitoba, a six-week field program was conducted in the "St. Lakes" area to evaluate sphagnum peat bogs identified from previous remote sensing investigations. Of the 25 bogs sampled, 8 appear to have high development potential, 6 have medium potential, and the remainder, low potential.

During 1989, several improvements were made to drill core facilities in Winnipeg, with additional core added to The Pas (3928 m), Lynn Lake (1617 m), Thompson (286 m) and Winnipeg (335 m). Work continued on the preparation of an Open File Report listing all holdings currently in the provincial system.

The Exploration Services Section continued to be active in a number of different fields, and generated several publications and brochures including the "Bibliography of Manitoba Geology 1795–1988". Early in 1989, the bibliographic data base was transferred from an IBM mainframe to the section's PC, greatly improving the ease of retrievals and searches. An Open File Report on platinum group metals (PGM) was also generated, and updates made to the mineral inventory cards. Assessment data were used to develop an update of the 1978 publication on geophysical work in the Flin Flon region, and supplements to the "Index to Non-confidential Assessment Reports" produced in May and November.

GEOLOGICAL SURVEY OF CANADA

The broad range of projects conducted by the Geological Survey of Canada (GSC in the province are reported in a separate publication to be issued as a GSC Open File at the province's annual Open House in Winnipeg, November 1989. This publication contains reviews of all projects conducted during the five-year period of the MDA as well as details of activities pursued during 1989. Three of the federally funded projects that involved substantial contributions by personnel from Manitoba are included within the provincial RFA and these are summarized as follows.

A study was conducted to examine the metamorphic mineral assemblages in the North Cook Lake alteration zone and to investigate the trace element variation in the host rocks of the occurrence.

Mapping of the Chisel Lake deposit at a scale of 1:1000 was undertaken as a joint project to take advantage of the excellent exposures created during the development of the open pit mine. The results of this study will be integrated with the results of the 1:5000 scale mapping reported earlier in this volume. The studies are likely to make a significant contribution to exploration strategies in the Chisel Lake Basin, especially in light of the important new discoveries being made by HBMS in this region.

A pilot study was conducted by research scientists at the University of Manitoba to investigate the possibility of geochemical haloes around the Bernic Lake rare-element-enriched pegmatite. Samples from drill core were analysed for a broad range of elements. Initial results indicating wide zones of elevated lithium and rubidium about the ore body may prove of use as an exploration tool in future searches for this kind of pegmatite.

GENERAL

Throughout the summer months, GSB staff led, and partook in, numerous field demonstrations of the Flin Flon–Snow Lake, Thompson and Lynn Lake areas for the benefit of industry and overseas geologists. GSB delegates took an active role in reporting on provincial programming at the September 11–13 Cluster meeting of the United States Geological Survey and state surveys in Bismark, North Dakota. Valuable new insights on MVT lead-zinc deposits were also gained through attendance at the Mid-Continent Cluster meeting at St. Louis, Missouri.

Ancillary projects included examination of new exposures at the Conawapa site on the Nelson River, backhoeing of sinkholes at Gypsumville for dating and paleontological studies in co-operation with personnel from the Museum of Man and Nature, and ongoing involvement with the exploratory activities of the Speleological Society of Manitoba.

The branch's new stratigrapher, Ruth Bezys, took over the responsibility of compiling the provincial contribution to the new "Geological Atlas of the Western Canadian Sedimentary Basin", co-ordinated by the Canadian Society of Petroleum Geologists.

In addition to numerous other publications issued throughout the year, the Branch also supported the redevelopment of the province's first "Geological Map Catalogue" which will act as a guide to the geoscientific map resources available for Manitoba.

As in previous years, branch staff also provided ongoing assistance to other components of the Minerals Division, in giving commodity reviews and mineral resource assessments for various sectors of the province.

Several meetings were held with members of the federally commissioned MDA evaluation team from Goss, Gilroy and Associates. This five-province evaluation program will assess the relative merits of MDA programming over the last five years, including extensive interviews and questionnaires with industry and other clientele to determine the effectiveness of the activities in the context of regional economic development.

On September 5th, the Department of Energy and Mines opened a new regional office at Flin Flon, staffed by a recording clerk and a District Geologist reporting to the Geological Services Branch. This extension of year-round services reflects the department's ongoing policy of supporting mineral-based communities and exploration endeavours in the most effective way possible.

Five-year workplans (1989-1994), encompassing contributions from the federal and provincial geological surveys are well advanced and incorporate numerous suggestions and recommendations from industry exploration personnel. Negotiations between the provinces and the federal government, regarding renewal of the MDAs, continued throughout the year. In August, at the Mines Minister's Conference in Sudbury, Ontario, the Minister of Energy, Mines and Resources announced the decision to proceed with new MDAs in the Maritime provinces. However, in western Canada, progress was limited to the setting of priorities for regional economic development through the Western Diversification Office.

In the absence of federal approvals for a new MDA, the GSC has embarked on its EXTECH program which will focus "A-Base" resources into multidisciplinary studies of the Snow Lake and Ruttan region over the next 2 to 3 years.

The provincial GSB will co-ordinate its capabilities in support of EXTECH as well as developing other initiatives supporting future mineral developments and environmental concerns.

Program planning for a Lithoprobe transect of the TransHudson Orogen is in the final stages. Should funding be approved in the spring of 1990, a multidisciplinary geophysical and geological program will be undertaken, mainly by the staff of the Department of Geological Sciences, University of Manitoba and the GSC. The purpose will be to study the Precambrian crust, from the northern Superior Province across the Thompson belt, and the Proterozoic magmatic arcs and intra-arc basins of the Churchill Province in Manitoba and Saskatchewan. With the inclusion of high-resolution seismic reflection surveys in selected areas, this program will provide new data of importance to the exploration industry. The GSB will contribute high-quality mapping in areas where such information is required. Reports dealing with the branch's past work in the Trans-Hudson Orogen are soon to be published in a special GAC symposium volume, along with the work of other agencies in Manitoba and neighbouring provinces.

Three new Precambrian bedrock geology compilation maps were issued during the last year. Additional maps in progress include sheets covering various sectors of the province underlain by Paleozoic rocks.

During the spring and summer of 1989, the province experienced one of the most widespread and extensive outbreaks of forest fires in recent history. Although considerable damage was sustained to timber resources, the fire also opened up large areas of new bedrock exposure with an attendant short-term opportunity for accelerated resource documentation. A comprehensive plan is currently under development that would take advantage of this "window of opportunity" for new mapping programs, especially in established mining districts with a proven potential for discovering new reserves. Fly-overs of burned areas were undertaken in October, and an operational plan will be tabled for consideration as part of the 1990–1991 estimates process.

Computer usage in Energy and Mines has grown substantially over the last year. Extensive changes have been made involving automated drafting and report production using AutoCad and desktop publishing systems. Major systems developments include: continuing enhancement of the Paleozoic Stratigraphic Corehole system and its integration with Petroleum Branch files; development of outcrop-level Precambrian geology bases; and ongoing evaluation of new Geographic Information Systems and spatial analysis software.

Finally, acknowledgements are made to Barry Bannatyne, Hugh McCabe and Joe Athayde, all of whom retired this year after many years of service with the Department. The contributions made by these individuals over the years will be remembered with sincere gratitude, and their integrity and industry will serve as a profound example for their successors to follow. In this context, and on behalf of the Branch, we welcome to their new positions Ruth Bezys (Stratigrapher), Dave Baldwin (Editor), Shirley Weselak (Word Processor operator) and Diana Kircz (Operations Co-ordinator).

ONTARIO MINISTRY OF NORTHERN DEVELOPMENT AND MINES
MINES AND MINERALS DIVISION
ONTARIO GEOLOGICAL SURVEY

During 1988–89, the Ontario Geological Survey (OGS) carried out detailed, regional and province-wide compilation geoscience studies. Locations of field projects are shown on Figure 1. Many projects were undertaken out in co-operation with Mines and Minerals Division geologists, universities and consulting firms. The Ministry supported applied research projects at Ontario universities through the Geoscience Research Grant Program and other grants.

A major effort of the OGS continues to be the "Geology of Ontario" project. This project consists of geological and geophysical compilation maps, and an accomanying volume, to mark the centennial of the OGS in 1991.

In 1988–89, a number of regional economic stimulation projects continued to be funded through the ministry's Northern Development Fund, and by the Canada–Ontario Mineral Development Agreement (COMDA).

PRECAMBRIAN GEOLOGY SECTION

The Precambrian Geology Section utilizes teams with cross-disciplinary skills to carry out projects integrating bedrock mapping with studies of mineral deposits and specialized research on the geology of the shield.

In 1988–89, the largest and most diverse project team continued work on the "Geology of Ontario" project, for which the Section will produce 1:1 000 000 scale bedrock and tectonic maps and an accompanying volume. Compilation of the bedrock geology map was completed in 1988–89; preparations for publication are in progress. Work on the tectonic map and the volume is currently underway. The "Geology of Ontario" project will provide an assessment of the degree of understanding of the geology of Ontario, and has already resulted in new models of the tectonic evolution of the shield. New models of the magmatic evolution of the shield are now emerging from this and other projects.

Other major projects included a study of the evolution of the Archean crust in the Abitibi belt in Ontario and a continuation of the section's study of Archean lode gold deposits. Work in the Abitibi belt included studies of granitic magmatism, structural and stratigraphic relationships across the Kirkland Lake–Larder Lake break, and two seismic reflection transects. The results of these projects will be used to construct a model for the evolution of the Abitibi belt, which will have analogues across the shield.

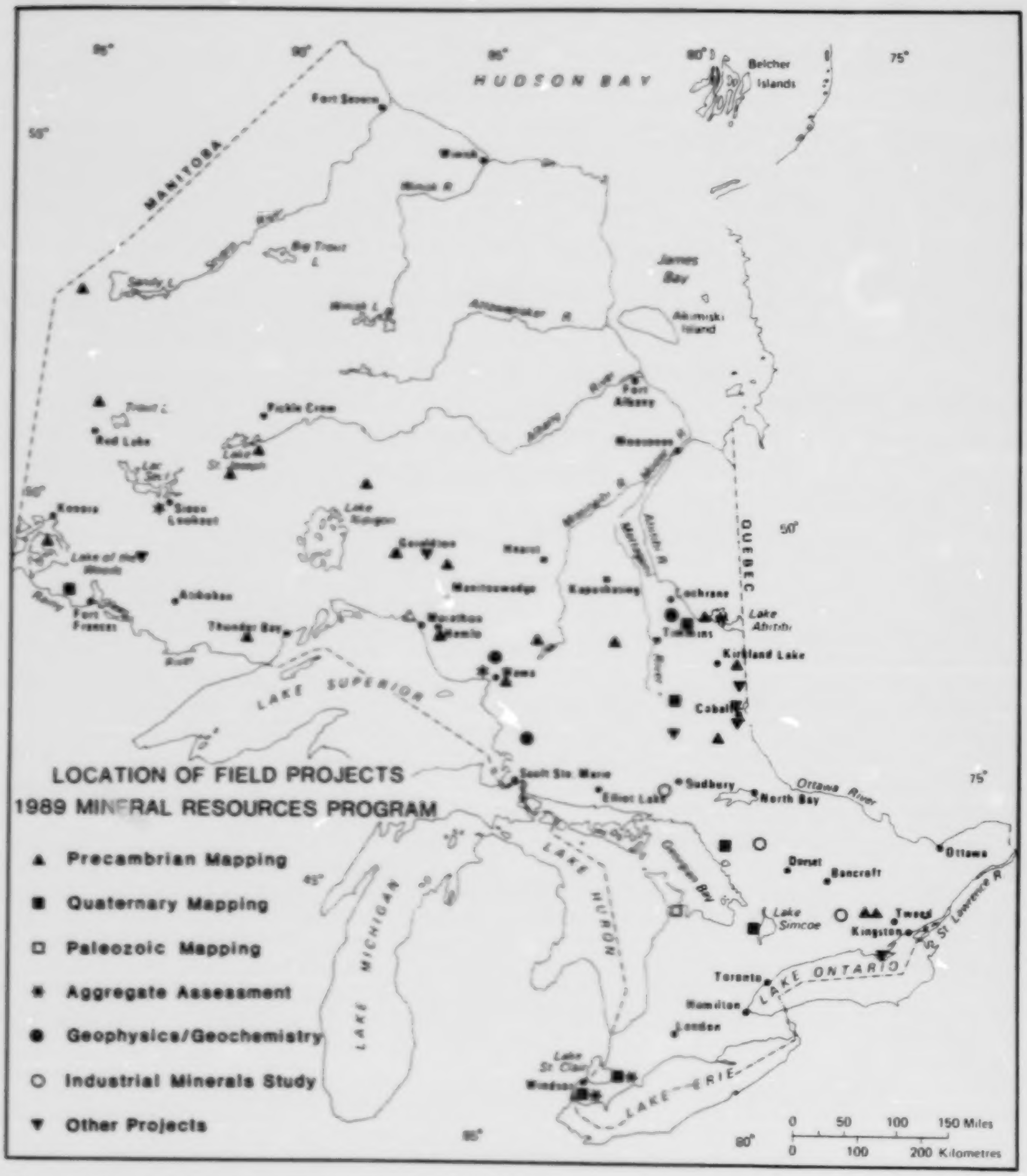

LOCATION OF FIELD PROJECTS
1989 MINERAL RESOURCES PROGRAM
▲ Precambrian Mapping
■ Quaternary Mapping
□ Paleozoic Mapping
* Aggregate Assessment
● Geophysics/Geochemistry
○ Industrial Minerals Study
▼ Other Projects
HUDSON BAY
Belcher Islands
MANITOBA
QUEBEC
Fort Severn
Big Trout L.
Sandy L.
James Bay
Akimiski Island
Attawapiskat R.
Albany River
Fort Albany
Pickle Crow
Trout L.
Red Lake
Lake St. Joseph
Lac Seul
Sioux Lookout
Kenora
Lake of the Woods
Lake Nipigon
Geraldton
Hearst
Moosonee
Kapuskasing
Manitouwadge
Cochrane
Lake Abitibi
Timmins
Atikokan
Fort Frances
Thunder Bay
Marathon
Hemlo
Kirkland Lake
Wawa
Cobalt
LAKE SUPERIOR
Sault Ste. Marie
Elliot Lake
Sudbury
North Bay
Ottawa River
Ottawa
Dorset
Bancroft
Georgian Bay
Lake Simcoe
Tweed
Kingston
St Lawrence R.
LAKE HURON
LAKE MICHIGAN
Toronto
LAKE ONTARIO
Hamilton
London
Lake St. Clair
Windsor
LAKE ERIE
95°
90°
85°
80°
75°
55°
50°
45°
0 50 100 150 Miles
0 100 200 Kilometres

Figure 1. Distribution and types of programs in Ontario

The section's program to document the geology of Archean lode gold deposits continued with detailed studies of the setting of mineralization in the Hemlo and Missanabie–Renabie areas and more general studies in the Swayze and Abitibi belts. In addition to this program of precious metals studies, the Section initiated a program to reassess the base metal potential of Ontario.

A diverse program of bedrock mapping, ranging from 1:10 000 to 1:50 000 scale, was carried out across the province. Included in this program were reconnaissance studies in the Berens River and Uchi subprovinces, and detailed mapping in the Uchi, Wabigoon, Abitibi and Grenville subprovinces. These mapping projects provide fundamental geoscience information to the mineral exploration industry, and are the basis for all of the section's activity.

Preparation of the first of a revised series of 1:250 000 scale geological compilation maps continued in 1988–89. These maps will display substantially greater geological and mineral deposits information than their current equivalents. Sets of maps, for the Ignace–Thunder Bay and Longlac–White River areas, are to be the first released.

Work continued on the development of a field-based, computerized system applicable to all varieties of mapping carried out by the Section. The first maps to be produced using this system, which utilizes a microcomputer to store, analyze and display field data, are nearing completion within the Section; publication will follow.

Joint research activities, which combine the special techniques and expertise of outside institutions with the geological expertise of the Section, are used to address specific problems in shield geology. In 1988–89, these included applications of geochronology, remote sensing and seismic reflection techniques. Precise U/Pb, with the Jack Satterly Geochronology Laboratory of the Royal Ontario Museum, and ^{40}Ar/^{39}Ar, with the Department of Physics, University of Toronto, geochronological techniques are being used to investigate the evolution of the Precambrian crust and of Archean lode gold deposits. Investigations, with the Ontario Centre for Remote Sensing, of possible applications of remote sensing to geology include: construction of an integrated geoscience data base for part of the Michipicoten greenstone belt near Wawa, the use of remotely sensed data to examine large-scale linear crustal features, and the use of studies of the spectral signatures of geochemically stressed vegetation in eastern Ontario. Seismic reflection studies with the Department of Physics, University of Toronto, and in co-ordination with the Canadian Lithoprobe program, are a significant contribution to the section's program to study the tectonic and magmatic evolution of the Abitibi greenstone belt.

ENGINEERING AND TERRAIN GEOLOGY SECTION

The Section fielded seven field parties as part of a program which covers the investigation of the Paleozoic and Quaternary rocks, and the assessment of the aggregate resources of the province. The field season was preceded by an extensive drilling campaign which provided third-dimension support for many projects.

Section staff were active in several professional organizations and scientific meetings throughout the year, and in developing the various contributions to the "Geology of Ontario" volume.

Paleozoic-Mesozoic Geology

During the field season, the staff completed a multi-year mapping project on the Bruce Peninsula, which emphasized the building stone potential of the area and clarified some long-standing stratigraphic questions.

Earlier in the year, drilling was undertaken to help with the investigation of potential new resources of brick-making shale. During the year, a three-volume series was released on the limestone industry in Ontario—a joint publication of the Ministry of Natural Resources and the Ministry of Northern Development and Mines.

Quaternary Geology

The Quaternary Geology Subsection continued its program of the surficial mapping of the province at a 1:50 000 scale.

Multi-year projects in southern Ontario were completed in Chatham–Romney and Windsor–Essex, and continued in the Barrie–Elmvale areas. The investigations in these areas are establishing the distribution, stratigraphy, and the glacial history of surficial materials. The work will assist meaningful planning towards a balancing of urban-industrial growth and environmental concerns.

In northern Ontario, mapping and drift sampling projects were concluded in the Geraldton–Beardmore, Shining Tree–Gowganda and Parry Sound–Sundridge areas. In the Fort Frances–Rainy River area, overburden drilling and sampling was undertaken to complement previously completed mapping of the area. Interpretation of the large overburden geochemical data base for the Matheson area continued with the release of the final set of maps. All data gathered during this Quaternary sampling program is now available on diskette. All of these projects will provide a geological inventory of the respective areas, and will aid in the development of effective drift exploration strategies through the establishment of glacial stratigraphies and the generation of geochemical data bases.

Structural Geology

The structural geological investigation of the Paleozoic and Quaternary deposits of Prince Edward County, southern Ontario, continued with detailed surface and geophysical studies of faults, "pop-ups", joint patterns and collapse structures.

Offshore, a side-scan sonar study of the lake bottom revealed the underwater extension of many features identified on land and also indicated the presence of some features which to date had not been identified on land. Early in the season, another mild earth tremor, magnitude 2.2 on the Richter scale, was recorded in the study area. This project is the major contribution of the Ontario Geological Survey to the activities of the Multi-Agency Group for Neotectonics in Eastern Canada (MAGNEC) and will provide updated information for the revision of the current National Building Code.

Aggregate Assessment

The staff of the Aggregate Assessment Office continued their assessment of the aggregate resources of townships in southern Ontario and detailed investigations of the buried aggregate potential of southwestern Ontario. Under COMDA, assessments of aggregate were completed in the towns of Bracebridge and Gravenhurst in the District Municipality of Muskoka, and in an area northwest of Fort Frances in northwestern Ontario. New projects were initiated in the Wawa and Sioux Lookout areas where, particularly in the latter, good aggregate supplies are not readily available.

GEOPHYSICS–GEOCHEMISTRY SECTION

Geophysics Program

During the 1988–89 field season, a project to research methods of detecting and tracing Precambrian rocks under thick Huronian sediments continued. An 80 line km gravity survey of part of the study area was completed in October 1988 with a further 110 line km of transient electromagnetic survey completed in another part of the study area in November 1988. Data from the gravity survey was released as OGS preliminary map P.3147 and data for the EM profiling was released on preliminary maps P.3133 and P.3141. A synopsis of the field surveys, and interpretation techniques researched for this project, will be released in the near future as Map 80 802. This project is funded under COMDA.

A project has been initiated to create a single, continuous Master Aeromagnetic Grid for Ontario. The digital aeromagnetic data set in non-graded form, from approximately 50 surveys, has been provided by the Geological Survey of Canada which is also participating in this project. The entire data set will be edited and levelled using a 2 km reference grid. A grid cell size of 200 m will be generated using the minimum curvature algorithm. A data base containing all the levelled information, in a flightline archive format, will also be generated for users. This newly created data base will yield several contributions to the Geology of Ontario volume: coloured, total field magnetic maps; and enhanced, processed derivative maps and shaded relief maps.

A research program into overburden sounding began during the summer season. It will investigate current methods and potential improvements for imaging the subsurface overburden stratigraphy in various areas of southern Ontario. An improvement in methods would be a valuable asset for projects requiring a detailed cross section of overburden materials. Projects involving subsurface construction engineering, environmental engineering and groundwater investigations currently rely on drilling technology for almost all data collected. Supplementary techniques, such as shallow seismic reflection and electromagnetic sounding, are being tested in a variety of Quaternary stratigraphic sequences as a first stage. A case history study on groundwater exploration is also currently underway.

Five airborne electromagnetic-magnetic surveys, covering areas of high mineral potential, were initiated in 1989. Approximately 78 000 line km were surveyed in the Sturgeon Lake–Savant Lake, North Swayze–Montcalm, Shining Tree, Batchawana and Rainy River areas. The results of two airborne electromagnetic surveys were released in June 1989. The Tashota–Geraldton–Long Lac area release consisted of 90 maps (Map 81 259 through 81 348) while the Detour–Burntbush–Abitibi area release was covered by 88 maps (Map 81 171 through 81 258).

Geochemistry Program

Commencing in mid-1988, two full-sized, coloured, regional geochemistry maps are being prepared. One map is of the Herman Lake area, north and east of Wawa, and the other is the Trout Lake area in the Batchawana greenstone belt. The latter project was carried out under the COMDA program. When these maps are released, they will be accompanied by a floppy disk containing the entire geochemical data base for each map area. These data bases are structured so that they can be input directly into a geographic information system (GIS).

During June 1989, field work for a regional geochemical survey of the Murray Lake area, northeast of Wawa, was completed with the collection of 487 lake sediment cores and lakewaters. The Murray Lake area lies to the east of the Goudreau Lake area which was sampled in 1987.

With the advent of precise and accurate multi-element geochemical data for lake sediments, plus the introduction of image processing and GIS into modern geochemical mapping, it is important that geochemists responsible for geochemical mapping keep abreast of current research. The research geochemist attended several conferences during the past year at which the results of OGS research were presented. Attendance at the 28th International Geological Congress was of particular importance because it included two sessions of presentations, and a poster session, on geochemical mapping worldwide. Information obtained from conferences has been incorporated into the two regional geochemical map sheets mentioned above.

GEOSCIENCE LABORATORIES

In 1989, the laboratories acquired a new X-ray diffraction system capable of routine search-match applications in mineral identification. A technique for the quantitative determination of mineral phases in rock powders is under investigation; the method involves studying simple mixtures of calcite, dolomite, and silicate minerals to determine total carbonate content and calcite:dolomite ratio.

The Frantz isodynamic magnetic separator in the Mineral Science Subsection has been upgraded with a low-field control, and there is now an enhanced ability to separate mineral phases. Preliminary studies on Keweenawan gabbro and Nipissing diabase samples indicate that good separations of pyroxenes and plagioclase feldspar can be achieved for chemical dissolution. This separation technique, combined with the powerful geoanalytical capabilities of inductively coupled plasma mass spectrometry (ICP-MS) will enable geologists to study the compositions of individual mineral phases in relatively fine-grained rocks.

Progress has been made in establishing an ICP-MS-based method for the determination of thorium, uranium, tantalum, and hafnium in silicate rocks, and considerable success has been achieved in resolving fine-scale variations in the geochemistry of basaltic rocks from the Keweenawan. The capability of ICP-MS to determine zirconium, niobium, strontium, and rubidium in rocks at levels below the determination limits of X-ray fluorescence is under investigation. Progress has also been made in the determination of the platinum group elements by a combined fire-assay and ICP-MS technique.

GEOSERVICES SECTION

The Geoservices Section consists of the Geoscience Information Services Subsection, the Publication and Cartographic Services Unit, and the Geoscience Data Centre.

The Geoscience Information Services Subsection provides an information and referencing service on the geology and mineral resources of Ontario to the mining and exploration industry and government. Clients have access to a comprehensive library of government reports and maps, geoscientific and technical texts and journals, as well as property reports submitted voluntarily by the exploration industry and for assessment credits under the Mining and Ontario Mineral Exploration Program acts. A Geoscience Information Officer is available to answer general geoscience inquiries from all sources and to prepare general interest publications and displays on geoscience topics.

The Publication and Cartographic Services unit has developed a "fast-track" report and map publication format which produces a typeset report and coloured map within 6 months of commencement of the editorial process.

A prototype "fast-track" report and map were reviewed at a June meeting of Mines and Minerals Division management with representatives of the Ontario Mineral Exploration Federation. The report and map received universal support. The first of these reports are to be released in December.

Refinements to the format, and software enhancements which will improve the quality of computerized cartographic artwork, are being developed. A colour chart for the "Zed-Carto" electronic colour separation system is being produced as a joint venture with the Geological Survey of Canada.

In June, "Proceedings of Exploration 87" was released as OGS Special Volume 3. This 914-page volume, which contains a 32-page colour folio of satellite imagery, maps and photographs, is the unit's first venture into the reproduction of colour plates.

The Geoscience Data Centre has released the Mineral Deposit Inventory (MDI), the first in the "Database for Microcomputers" series for use on personal computers. The MDI data base system provides clients with portable access to geological information on close to 6000 of the province's metallic and industrial mineral deposits.

Research on the application of GIS to geological data, carried out under the GEOSIS project, is continuing and several papers and presentations of this work were given by staff during the course of the year.

Development has been initiated on the first phase of the "Mineral Resources Inventory" system, which, when fully implemented, will provide our clients, through Resident Geologist offices and Geoscience Information centres, with Ontario-wide access to integrated and up-to-date digitized data bases based on the research and development work carried out under GEOSIS.

GEOSCIENCE RESEARCH GRANTS

In 1989, the Ontario Geoscience Research Grant (OGRG) program awarded 22 grants, totalling $500 000, to seven Ontario universities. The grant program finances mission-oriented geoscience research in Ontario, research which complements but does not duplicate the activities of the OGS. Oral and poster presentations by OGRG recipients for the previous year were presented during the annual OGS

Geoscience Research Seminar at the Ontario Mines and Minerals Symposium held on December 12-14, 1988 at the Metro Convention Centre.

The following projects, combining OGS and outside expertise, were partly funded by Ministry geoscience research grants. As mentioned earlier, U/Pb and ^{40}Ar/^{39}Ar geochronology work is being carried out at the Royal Ontario Museum and the University of Toronto, respectively. Crustal studies in the Kapuskasing region are underway at the Geology Department, McMaster University, as part of the Canadian Continential Drilling and Lithoprobe programs.

MINISTÈRE DE L'ÉNERGIE ET DES RESSOURCES
GOUVERNEMENT DU QUÉBEC
SECTEUR "MINES"

Pour l'année financière 1989-90 l'objectif de base du ministre, en ce qui concerne le secteur "Mines", est de promouvoir le développement de l'industrie minérale du Québec par un ensemble de mesures visant à appuyer l'initiative et le direction du secteur privé, tout en s'assurant que l'exploitation des ressources minérales se fait selon les meilleurs intérêts des Québécois. Plus particulièrement, il s'agit de:

1. stimuler les investissements privés pour le développement de nouveaux gisements, l'expansion des capacités de production existantes et le modernisation des usines de première transformation;

2. localiser le recherche et le développement sur des projets spécifiques repondant aux besoins de l'industrie et pouvant aider à consolider notre position concurrentielle, et susciter le développement industriel à court et moyen termes;

3. contribuer au renouvellement des réserves domestiques pour les minérales de cuivre et de zinc, et favoriser le diversification de la production minérale dans les régions du Québec par la stimulation de l'exploration minière;

4. assurer la promotion et la défense de l'amiante et, au niveau mondial, promouvoir l'adoption de législations visant un usage sécuritaire de ce produit.

Chacune des trois directions générales du secteur "Mines", ainsi que la direction de la politique et de l'évaluation, répond plus spécifiquement à l'un ou l'autre des grands objectifs cités.

DIRECTION DE LA POLITIQUE ET DE L'ÉVALUATION

Financement et fiscalité

Le Gouvernement du Québec a poursuivi en 1989 sa politique fiscale d'encouragement au financement de l'exploration par actions accréditives. Les frais d'exploration définis comme "frais de surface" engagés au Québec par un particulier sont devenus admissibles, à compter de l'année d'imposition 1989, à une déduction de 166 2/3%; les frais souterrains de puits, rampes ou galeries d'exploration ou de forage sous terre demeurent valables pour une déduction de 133 1/3%. Outre que ces allocations à l'impôt du Québec peuvent s'appliquer aux dépenses admissibles au programme fédéral PSEMC, elles ont aussi été prolongées jusqu'à la fin de 1990. De plus, à compter de l'année d'imposition 1989, les frais d'exploration qui sont admissibles aux allocations additionnelles de 33 1/3% ou de 66 2/3%, selon le cas, n'entrent plus au calcul des pertes nettes cumulatives sur placements (PNCP) à l'impôt du Québec.

Cependant, même si certaines découvertes (Ressources Aur, Audrey, VSM) ont contribué à susciter de l'intérêt pour le secteur de l'exploration, les dépenses d'exploration au Québec financées par actions accréditives ont néanmoins baissé de 155M$ en 1988 à environ 75M$ en 1989.

Le régime fiscal québécois comprend aussi d'autres mesures incitatives destinées à faciliter le financement, en particulier les actions admissibles au Régime d'épargne-actions du Québec et le financement des dépenses de R & D.

Le lecteur est prié de se referer à la rubrique "Droits sur les mines" pour connaître les principales modalités de cette loi.

Service de la statistique et des opérations

Le Service de la statistique et des opérations a la responsabilité de fournir au secteur "Mines" toutes les données statistiques que lui sont nécessaires afin de remplir son mandat. Ces données sont recueillies auprès des entreprises oeuvrant dans le secteur minier au Québec.

Plusieurs de ces données sont publiées chaque année au moyen de 10 publications différentes. Sept de ces publications sont de nature quantitative et trois de nature qualitative.

Liste des publications:

- Statistiques sur l'investissement de l'industrie minérale du Québec
- Portrait statistique de l'industrie minière québécoise
- Statistiques sur l'industrie minérale
- Statistiques de la production minérale (mensuel)
- Statistiques de la production minérale – Pierre concassée (mensuel)
- Statistiques sur les mines d'or du Québec – 1987
- Statistiques sur les mines d'amiante du Québec – 1987
- Répertoire des établissements menant des opérations minières au Québec
- Annuaire des administrateurs des compagnies minières
- Renseignements sur les compagnies minières (trimestriel)

LA DIRECTION GÉNÉRALE DE L'INDUSTRIE MINÉRALE (DGIM)

La mandat de la DGIM est de favoriser le développement, l'exploitation et la transformation des ressources minérales du Québec par l'entreprise privée. Elle administre des programmes d'assistance financière et les législations minières. De plus, cette direction générale analyse les facteurs économiques et réglementaires qui ont une incidence sur l'industrie minérale en vue d'en dégager les orientations et les programmes gouvernementaux susceptibles de contribuer à l'essor des entreprises minières oeuvrant au Québec.

Programmes d'assistance financière

Infrastructures de développement minéral:
Ce programme est inscrit dans le cadre de l'Entente auxiliaire Canada–Québec sur le développement minéral. Son objectif est de favoriser l'implantation de nouvelles installations de production et de transformation de minéraux au Québec qui soient hautement productives et concurrentielles au plan

mondial, grâce à une intervention gouvernementale qui assurera l'implantation des infrastructures nécessaires à leur avènement. En vertu de ce programme, la contribution des gouvernements au coût de construction des infrastructures (routes, lignes électriques, points, pipe-lines, sites résidentiels, aqueducs, égouts, etc.) pourra atteindre 20% du coût total du projet d'immobilisation. Le programme actuel prendra fin le 31 mars 1990.

Études technico-économiques:
L'objectif de ce programme est de favoriser l'élaboration de projets industriels miniers et d'inciter l'industrie minérale à analyser diverses avenues susceptibles d'améliorer sa productivité et sa compétitivité. En vertu de ce programme, une assistance financière de 50% du cout de réalisation d'études technico-économiques et de travaux d'expérimentation destinés à vérifier la praticabilité ou la viabilité économique d'un projet peut être accordée, avec un maximum de 250 000 $ par projet.

Impôt sur le revenue:
L'allocation de 66 2/3% pour frais d'exploration engagés au Québec par un particulier a été abrogée le 11 décembre 1986. Depuis cette date, les règles fiscales favorisant le financement de l'exploration sont sensiblement les mémes au Québec et au niveau fedéral: un contribuable peut déduire de ses revenus de toutes sources 100% de certains frais d'exploration, plus une allocation de 33 1/3% de ces frais, jusqu'à concurrence de 33 1/3% de son revenu (la limite est de 25% au fédéral).

Un particulier peut aussi déduire dans le calcul de son revenu imposable un montant variant de 50% à 100% du coût des actions admissibles au Régime d'épargne-actions du Québec. Le pourcentage varie selon la taille des actifs de la compagnie; il varie également suivant que les actions ont ou n'ont pas plein droit de vote.

Il convient aussi de signaler les nouvelles mesures fiscales concernant la recherche et le développement (R & D) qui ont été introduites dans le Discours du budget du 30 avril 1987. Pour les corporations, le crédit d'impôt sur les salaires versés à la R & D passe de 10% à 20%; le taux passe à 40% des dépenses courantes ou en capital si la R & D est faite dans une entité universitaire admissible. Les particuliers peuvent se prévaloir d'une déduction de 133 1/3% pour le financement de la R & D. La déduction est de 166 2/3% pour le recherche universitaire. Finalement, un chercheur étranger recruté par une entreprise peut bénéficier d'un congé fiscal de 24 mois.

Loi sur les mines

L'Assemblée nationale du Québec a adopté, le 23 juin 1987, le Loi sur les mines (projet 161, 1987, chapitre 64) dont la mise en vigueur a été proclamée le 24 october 1988. Le permis de prospection sera valide pour cinq ans; la période de validité du claim est portée à deux ans et il est renouvelable. Le période de validité du bail minier est fixée à vingt ans et le délai pour commencer l'exploitation minière est de quatre ans.

Dans certains territoires du Sud du Québec, l'acquisition des claims se fera par désignation sur carte; au nord du 52° de latitude, le titulaire d'un permis d'exploration pourra enregistrer un claim sur tout le territoire (ou une partie du territoire) visé par son permis d'exploration.

Enfin, la loi assujettit certaines décisions du Ministre à la possibilité d'un appel à la Cour provinciale ainsi que d'un appel, sur permission, à la Cour d'appel.

Droits sur les mines

Sommairement, la Loi concernant les droits sur les mines comporte les modalités suivantes (certaines mesures sont en vigueur depuis le 24 avril 1985):

- la déduction à 100% des frais d'exploration et de mise en valeur;

- une allocation pour dépréciation de 30% du coût des actifs dépréciables;

- une allocation additionnelle de 33 1/3% de certaines dépenses prescrites;
- une allocation pour traitement égale à 8% ou à 15%, selon le stade de transformation, du coût des actifs dépréciables;
- le profit minier est assujetti à un taux fixe de taxation de 18%;
- les droits payables sont réduits d'un crédit annuel de 90 000$. La partie inutilisée de ce crédit est reportable sur les trois exercices financiers ultérieurs;
- un crédit remboursable de 18% est applicable s'il y a perte. Ce credit est égal au moindre de 18% de la perte d'une année et de 18% des dépenses d'exploration, de mise en valeur et de la dépréciation déduites au cours de cette année;
- la partie d'une perte non admissible au crédit remboursable est reportable sur les trois exercices financiers antérieurs et les sept suivants.

Le Centre de Recherches Minérales (CRM)

Le Centre de recherches minérales (CRM) fait partie intégrante du secteur "Mines" du ministère de l'Energie et des ressources. Sa mission est d'offrir une aide scientifique et technique axée sur la découverte, la mise en valeur, l'exploitation, la transformation et l'utilisation des ressources minérales. Ses nombreuses ressources lui permettent d'occuper une place de choix en recherche appliquée dans le secteur des mines et de la métallurgie. Son domaine d'action comprend l'analyse minérale, la minéralurgie, la métallurgie et la technologie miniére.

Au cours de l'année 1988-1989, le CRM a poursuivi activement ses efforts pour répondre aux besoins accrus de l'industrie minérale en matière de développement technologique. Il a analysé près de 45 000 échantillons représentant environ 900 000 déterminations pour un coût de 1,5 million de dollars. De plus, il a accordé des contrats d'analyse pour une valeur de 127 000 $. En outre, dans le secteur analytique, il a effectué plusieurs projets en commandite avec l'industrie, en formation de personnel technique, en optimisation de systèmes majeurs d'analyse et en développement de systèmes informatisés de gestion analytique. En minéralogie appliquée il a poursuivi ses activités; il posséde des instruments munis des derniers perfectionnements en matière de microscopie électronique à balayage, de microscopie optique, de diffractométrie aux rayons-x et d'analyse thermique.

En minéralurgie, le CRM a traité plus de 200 projets pour une valeur de plus de 3,8 millions de dollars; 70% de ces projets étaient commandités par les entreprises. Le CRM a particuliérement été actif dans le domaine des minerals de graphite et de magnésium. Le graphite en paillettes suscite beaucoup d'intérêt en raison du développement de nouvelles applications à fort potentiel. D'autre part, le CRM a participé activement au projet Magnola qui vise à produire le magnésium sous forme métallique à partir des rejets d'amiante.

Dans le secteur du traitement des minerais de fer, l'activité a continué à être forte. En collaboration avec l'industrie, le CRM a développé une technique pour produire des boulettes plus spécialisées. Il a mis au point un essai effectué en laboratoire pour simuler la réduction directe ce qui permettra le développement de boulettes de meilleure qualité. En mars 1989, le CRM a organisé, en collaboration avec le CRIQ, un deuxiéme colloque sur les minéraux industriels. Les activités dans le domaine du contrôle de procédés ont connu une croissance remarquable au cours de l'année.

En technologie miniére, le CRM est actif en contrôle du terrain, en génie industriel minier et en environnement minier. Il a poursuivi la publication de guides pratiques d'ingénierie commencée en 1986. Il s'est impliqué dans la préparation d'un ambitieux programme de neutralisation des eaux de drainage dans l'environnement minier (NEDEM). Il a collaboré aussi avec l'Association minière du Québec (AMQ) et l'Université Laval à la mise sur pied d'un important programme de recherche sur les gisements dits filoniens. Somme toute, en 1988-1989, le CRM a recontrà les objectifs qu'il s'était fixé.

Au cours des six premiers mois de l'année 1989-1990, la demande d'analyses en provenance du CRM s'est accrue, provoquée par la réalisation de travaux commandités, particulièrement à l'usine-pilote. En effet, deux gros projets dont celui de Magnola, ont exigé un trés grand nombre d'analyses pendant les phases de pilotage. Par contre, les activités commandités en minéralogie dans le secteur de l'or ont connu un certain recul.

En minéralurgie, les résultats pour les six premiers mois de l'année en cours sont nettement en avance sur les objectifs, en ce qui a trait aux projets commandités. En effet, la valeur des projets réalisés totalise plus de 1,6 millions de dollars alors que le carnet de commande est de 1,2 millions de dollars. On prévoit que les objectifs de projets commandités seront dépassés pour l'année.

En technologie minière, le personnel est pleinement occupé par des projets sous contrat avec diverses entreprises. Les objectifs de réalisation et de revenus seront tout probablement atteints. Une semaine d'échanges et de formation technologiques a été organisée en novembre 1989 par le CRM en collaboration avec quatre autres organismes du secteur des mines. Cette semaine d'activité s'est déroulée au Collége de l'Abitibi–Témiscamingue et incluait un colloque sur l'informatique appliquée aux mines, un colloque sur les gisements filoniens et les équipements miniers et un atelier de modélisation des structures minières.

En 1989-1990, deux activités importantes ont été ajoutées à la programmation des groupes de minéralurgie et de technologie miniere: la premiére était le volet technologique de l'Entente auxiliaire Canada/Québec sur le développement minéral (2,0 millions de dollars sur deux ans) et la deuxiéme a été l'instauration de la partie quebecoise du programme NEDEM (400 000 de dollars par an, pendant 5 ans). Dans le cas de l'EADM, onze projets sont prévus; en ce qui a trait au programme NEDEM, les projets sont réalisés surtout par des organismes externes tels que l'Université Laval, le CRIQ, McGill, etc. Ces activités importantes sont le fruit d'une collaboration très étroite entre le CRM et CANMET.

DIRECTION GÉNÉRALE DE L'EXPLORATION GÉOLOGIQUE ET MINÉRALE (DGEGM)

L'année financière 1989/90 fut comme l'année précédente marquée par un haut niveau d'activités en acquisition de connaissances géoscientifiques et par la consolidation du programme d'assistance financière à l'exploration minière. L'année 1989-90 est aussi la dernière année de l'entente auxiliaire Canada–Québec sur le développement minéral.

La DGEGM a consacré près de 12,8 millions de dollars sur le volet "acquisition de connaissances" et un montant de 8,1 millions de dollars a été consacré à des programmes d'assistance financière à l'exploration ainsi qu'à la préparation et à la diffusion de la géoinformation.

Direction de la recherche géologique

La direction de la recherche géologique (DRG) a pour mandat d'étendre et de raffiner la connaissance géologique de base du territoire afin d'en arriver à l'identification de zones à potentiel minéral élevé.

Pour la mise en oeuvre de ses programmes, la DRG a recours à un service de géochimie/géophysique, à deux services géologiques (Nord-Ouest et Québec) et à une division des opérations de terrain.

Service géologique de Québec

Division Côte-Nord – Nouveau-Québec:
Cette division dispose d'un budget de 1650,5 K$ dont 317,3 K$ ont été consacrés à la Fosse de l'Ungava, 794,8 K$ à la Fosse du Labrador (incluant son avant et son arrière-pays) et 516,7 K$ à la Côte-Nord.

Les travaux réalisés dans la Fosse de l'Ungava ont porté sur la vérification des travaux de cartographie à 1:50 000 réalisés au cours des six années précédentes et sur la finalisation des recherches métallogéniques destinées à mieux définir le potentiel économique de ces terrains. La synthèse de toute l'information recueillie au cours de ces années est présentement en cours et sera publiée sous forme de mémoire. Cette année encore, les travaux de la Division dans ce secteur ont suscité l'intérêt des compagnies d'exploration pour la recherche de platinoides, d'or et de métaux de base.

Dans la Fosse du Labrador de même que dans les roches du Supérieur en son côté ouest, les recherches métallogéniques se sont poursuivies. Un projet de reconnaissance géologique et gîtologique a été initie dans les unités de la province de Churchill en son côté est. Les montants consentis à la recherche sur la Côte-Nord ont sensiblement augmenté par rapport à l'an dernier; passant de 271,0 K$ à 516,7 K$, ils reflètent la volonté du secteur Mines d'intensifier les travaux dans cette région. Une planification pour les cinq prochaines années a été préparée, comprenant des travaux de reconnaissance en géochimie, géophysique, la réalisation d'une couverture cartographique à 1:50 000 des secteurs les plus favorables et les plus accessibles le long du littoral et sur des recherches quant au potentiel métallifère des roches mafiques et ultramafiques au voisinage de la structure de Manicouagan jusqu'au sud de Fermont.

Division Montréal–Laurentides:
Cette division compte sur sensiblement le même budget que l'année dernière (411,5 K$). Les travaux de cartographie déjà entrepris dans les régions de Thurso et de Maniwaki se sont poursuivis.

Division Estrie–Laurentides:
Cette division dispose d'un budget de 757,0 K$, dont la majeure partie à été consacrée à la continuation des travaux de cartographie aux voisinages de Sherbrooke et de Montmagny. Les recherches visant à caractériser le volcanisme appalachien et à identifier ses liens avec la mise en place de la minéralisation se sont aussi poursuivies. Le segment du Grenville qui relève de cette division a été, au cours de l'année, l'objet d'une activité minière inhabituelle avec l'intérêt suscité par la présence de sulfures cupro-nickelifères en bordure d'une masse d'anorthosite au nord du lac Saint-Jean. Si la valeur des indices mis à jour dans cette région se concrétise, il y aura lieu de réévaluer le potentiel de toutes les masses d'anorthosite dans le Grenville.

Division Gaspésie – Les îles:
La Division Gaspésie - Les Îles mise sur un budget de 743,2 K$ pour la réalisation du programme visant à produire une nouvelle couverture cartographique à 1:50 000 et à continuer des études structurales et métallogéniques le long des structures les plus favorables, dont les failles du mont de la Serpentine et la faille du Grand Pabos. Rappelons que c'est le long de la faille du Grand Pabos que sont concentrés la plupart des indices minéralisés mis à jour dans le sud de la Gaspésie et que, encore tout dernièrement, cette faille a été le théâtre d'une découverte en bismuth et en or grâce à la persévérance de membres de l'Association des prospecteurs de la Gaspésie.

Division des Minéraux Industriels:
La Division des minéraux industriels consacre son budget, de 515,3 K$, à la poursuite des inventaires des sources de granulats, de tourbe, de silice, de calcaire, de dolomie et de granite architectural. Elle compte rendre public, prochainement, une série de rapports destinés à faire connaître le potentiel québécois pour diverses substances spécifiques, dont les terres rares, les phosphates et les sources en magnésium pour la production de magnésium métal.

Service Géologique du Nord-Quest

Le Service géologique du Nord-Ouest (SGNO) dessert le Nord-Ouest québécois. Les trois divisions de Rouyn-Noranda, de Val-d'Or et de Chibougamau, chacune animée par un géologue résident, sont logées dans les bureaux régionaux des mines. La Division des gîtes minéraux, également animée par un géologue résident, de même que le personnel de la direction du Service, sont regroupés dans le bureau de Val-d'Or.

Au cours de l'année 1989-90, le SGNO a consacré un budget de 3 178 K$ à la réalisation de 22 nouveaux projets et à la finalisation de 11 projets entrepris l'année précédente. Les nouveaux projets comprennent six levés détaillés, cinq synthesès et 11 études spécifiques.

Levés Détaillés

Les levés détaillés ont été réalisés à l'échelle de 1:20 000. Deux sont à leur première phase. L'un des deux est un levé structural dans le secteur du lac De Montigny près de Val-d'Or; Claude Hubert de l'Université de Montréal participe à ce projet. L'autre est un levé géologique qui vise la bande de roches volcaniques entre les cantons de Vezza et de Bruneau au sud de Matagami. Trois levés constituent des étapes dans des levés pluri-annuels, l'un dans le secteur Carpentier-Tavernier, l'autre dans la bande Caopatina-Desmaraisville, et le troisième dans le secteur Urban-Barry. Quant au secteur des mines de Chapais, il est terminé; la rédaction du rapport final (synthèse des données avec carte en couleur) est amorcée.

Synthèses

L'objectif des cinq synthèses en cours est de parvenir à une interprétation globale de secteurs particuliers du Nord-Ouest. Trois d'entre elles ont requis des travaux de terrain. Ce sont celles désignées comme projets Blake River, Porcupine-Destor et lac Madeleine, le dernier ayant nécessité un levé à 1:20 000. Soulignons que les projets Blake River et lac Madeleine sont à leur étape finale alors que le projet Porcupine-Destor est nouveau et prendra de l'ampleur au cours des prochaines années.

La synthèse Frotet-Troïlus vise la mise à jour de la base de données acquise de 1978 à 1983 et la production de cartes finales après révision des interprétations existantes. Quant à celle des granitoïdes de la région de Rouyn-Noranda, dirigée par Maurice Rive, elle est à l'étape finale. Elle sera complétée par les résultats de la géochimie des roches réalisée par Hillar Printson et John Ludden de l'Université de Montréal.

Études Spécifiques

Parmi ces études, dix relèvent de la Division des gîtes minéraux:

- Les projets pluriannuels portant sur les métaux de haute technologie et les métaux de base, tous deux réalisés par l'IREM, se sont poursuivis comme prévu.

- La phase finale du projet Chibex-Lac Shortt réalisée par le CERM (UQAC) a été amorcée. Rappelons que le projet vise l'étude exhaustive des mines aurifères Lac Shortt et Joe Mann (Chibex), de même que celle de plusieurs indices auriferes.

- L'étude des gîtes aurifères de la région de Rouyn-Noranda s'est poursuivie. L'étude des gîtes Francoeur et Duquesne est menée par les métallogénistes du Service, en collaboration avec les géologues de l'industrie et avec le concours de l'INRS pour certains travaux analytiques.

- Les études concernant les gîtes McWatters et Elder, de même que celle sur les sites aurifères de la région de Belleterre, ont été confiées à des organismes québécois de recherche: IREM et UQAM.

- L'étude métallogénique du corridor Matagami-Radisson a été amorcée. Une première phase de compilation sera suivie, au cours des années à venir, de travaux de terrain. Ce nouveau projet marque l'entrée du MER dans une activité appelée à prendre de l'importance, et qui requiert le support de la géomatique et de systèmes experts, dans le développement desquels il est résolument engagé.

- Un nouveau projet de géochronologie a été confié à l'UQAM. La base de données géoscientifiques du Québec est très pauvre en dates fiables et il y a lieu de combler cette lacune.

Service de la Géochimie et de la Géophysique

Le budget du Service pour l'année financière 1989-90 a été de 2,761 K$ et il a permis la réalisation de 20 nouveaux projets dont les grandes lignes des principaux sont énoncés ci-après.

Division de la géochimie:

- **Sédiments de lac: Blanc-Sablon**

Une campagne d'inventaire géochimique se poursuit sur la Côte-Nord. Plus de 3 200 échantillons sont prélevés à raison d'un échantillon par 13 kilomètres carrés.

- **Till: Louvicourt**

Ce projet consiste en un énchantillonnage systématique (400 sites) du till dans les cantons de Louvicourt, Maria, Vauquelin et Villebon.

Ce projet est la continuation d'un vaste inventaire géochimique de l'Abitibi par la méthode du tili de base (entrepris en 1971 et cumulant près de 8 000 site d'échantillonnage, par Pionjar). Il permettra d'identifier les dispersions métalliques dans le till. Les échantillons prélevés lors de la phase initiale ont été récemment réanalysés pour l'or et quelques traceurs aurifères (As, ag, Sb et W).

- **Mobilité du platine**

Le présent projet vise à établir sous quelles formes – minéral, complexe organique, etc. – se présentent le Pt et le Pd et comment ils sont modifiés entre le moment de leur libération de la roche mère et celui de leur déposition dans les sédiments lacustres. Cela devrait permettre de mieux comprendre l'ensemble des facteurs physico-chimiques qui influencent la dispersion des EGP et, par le fait même, de mieux orienter la prospection géochimique pour ces substances.

- **Banque d'analyses de roches (BAROQ)**

On vise à monter un systémo informatisé de stockage des résultats d'analyse des roches du Québec. Le travail de cette année se divise en trois parties: rodage du système; production et traitement; promotion.

L'essentiel des tests permettant de roder le système informatisé a été effectué au cours du printemps et de l'été 1989.

L'étape production se traduira par la récupération et le stockage des données d'analyses de roches de l'année 1988 et celles de l'année en cours. Au printemps 1990, le système stockera près de 9 000 échantillons, tous localisés, et représentant plus de 468 000 résultats d'analyses. Le traitement et l'accès à l'information stockée sera disponible à l'automne 1989.

En géochimie, les autres projets ont été ceux des minéraux lourds dans la région de Manicouagan, dans la région de Portneuf et de la Mauricie, des analyses du plantine, de la mobilité du platine, de la récupération d'échantillons, des réanalyses d'échantillons de la région de la Gaspésie, et de la méthodologie des minéraux lourds.

Division de la géophysique:

- **Levé Input dans la région du lac Opasatica**

Un projet de levé électromagnétique aéroporté dans la région du lac Opasatica a été confié à la firme SIAL Géosciences Inc. La région couverte est sise à une dizaine de milles au sud-ouest de la ville de Rouyn-Noranda et comprend les feuillets 32D/3-200-101, 102, 201.

Le projet fait partie de l'inventaire INPUT systématique de l'Abitibi. On prévoit la publication de cartes magnétiques et électro-magnétiques à 1:20 000 et à 1:50 000, en blanc et noir et en couleur. L'information géophysique digitalisée sera versée dans la banque de géophysique (MAGGY).

- **Levé Input dans la région du lac Midway**

Un projet de levé électromagnétique aéroporté dans la région du lac Midway a été confié à la firme SIAL Géosciences Inc. La région visée est sise à une vingtaine de milles au sud de Fermont et comprend les feuillets suivants: 23B/6-202; 23B/7-201; 23B/10-101; 23B/11-102. Elle montre des indications économiques de graphite (gîte de Mazarin) ainsi que des indices de cuivre. On publiera des cartes à 1:20 000 et à 1:50 000, entre autres celles du champ magnétique total, des anomalies électromagnétiques et du gradient magnétique.

- **Interprétation géophysique dans la région de Chapais**

Ce projet fait partie de la réévaluation de la géologie de la région de Chapais (feuillet 32G/15), à l'aide d'une synthèse des différentes données géophysiques et géologiques existantes. L'outil principal de l'interprétation provient d'un levé gravimétrique effectué dans cette région à l'automne 1987. Le levé a été complété à l'ete 1989 par une campagne d'échantillonnage de roches afin de faire ressortir les mesures de densité et de susceptibilité magnétique pour chacune des formations géologiques.

Le traitement des données gravimétriques permet de modéliser en deux dimensions des corps géologiques en profondeur, en tenant compte de la géologie et des structures connues en surface. Une quinzaine de coupes à travers la région ont été modélisées dans le but d'améliorer la cartographie géologique et structurale. Ce projet, sous la direction de Denis-Jacques Dion, assisté de Hélène Church, se fait en collaboration avec le géologue régional de la région de Chapais, Rémy Morin. Pierre Keating de la Commission geologique du Canada traite les données du champ magnétique.

En géophysique, les autres projets ont été ceux de la gravimetrie dans la région de Manicouagan, de la spectrométrie dans la région de la Rivière Goodwood, de l'épuration des données géophysiques digitales et de la banque de données géophysiques.

DIRECTION DE L'ASSISTANCE A L'EXPLORATION MINIÈRE

Service d'assistance Technique et Financière

La division des programmes d'aide à l'exploration a géré trois programmes d'assistance financière en 1989-1990. Ces programmes, qui font partie d'ententes fédérales-provinciales, sont:

1. Le programme d'assistance financière à la prospection dans la région du Bas-Saint-Laurent et de la Gaspésie.

2. Le programme d'assistance financière à la prospection minière en Estrie-Beauce.

3. L'assistance financière pour le soutien de l'exploration minière dans les communautés minières en difficulté.

Dans le cadre du programme de la Gaspésie, 95 prospecteurs ont bénéficié d'assistance financière et neuf propriétés ont été amenées à des stades où elles sont maintenant prêtes pour des campagnes d'exploration avancées.

Dans la région de l'Estrie-Beauce, quinze subventions ont été accordées pour appuyer des projets d'autant de compagnies. Un programme de sensibilisation du milieu à l'exploration est au stage de l'organisation et cherchera à favoriser l'implication de la population.

Dans le cadre du soutien aux communautés en difficulté, une subvention fut accordée à Explorations Noranda à Murdochville, ainsi qu'en Gaspésie. Cette subvention vise à encourager la diversification et la découverte de nouvelles réserves qui assureront la survie de l'industrie minière en Gaspésie.

Un total de 3 M$ fut accordé en subventions à l'exploration en 1989-90.

La division de la mise en valeur de la géoinformation a continué à oeuvrer à l'informatisation de son fichier sur les gîtes du Québec. Environ 6 000 fiches ont été transposées du format manuel au format informatique et intégrées au nouveau système, et environ 400 fiches ont été mises à jour. Les listes mensuelles des nouveaux indices minéreaux ont été préparées et mises à la disposition du public pour consultation. Des cartes minérales sont à l'impression pour les régions de l'Estrie-Beauce et de la Fosse du Labrador et la carte de la Gaspésie sera préparée sous peu par géomatique. Les deux premières seront publiées sous peu et la dernière dans un an.

La mise à jour des cartes de localisation des travaux géoscientifiques s'est poursuivie. Une nouvelle équipe de travail a été mise sur pied pour terminer l'ensemble de cette mise à jour. Ainsi, deux des trois principaux produits de compilation du Ministère seront bientôt en état d'être incorporés au futur système d'information géoscientifique à références spatiales.

Service de la Géoinformation

Le Ministère a évaluà les résultats de la mise à l'essai de techniques géomatiques et d'un système expérimental d'information géoscientifiques à référence spatiale. Cette évaluation a confirmé la faisabilité et l'opportunité d'utiliser les technologies de géomatique dans la production, la gestion et la diffusion des données à référence spatiale du Ministère.

Suite à un appel d'offre public, le Ministère a confié à un consortium spécialisé dans le domaine la réalisation d'un plan détaillé d'introduction de la géomatique au sein de ses opérations courantes.

Le Ministère donne ainsi suite à son intention de consacrer prioritairement ses efforts à implanter un sytème d'information géominière à référence spatiale afin de le conduire, lui et sa clientèle, à des modes de gestion mieux adaptés aux exigences des années 90.

Par ailleurs, au cours de l'exercice financier 1988-89, le Service a édité et mis à la disposition du public, 104 nouveaux documents géoscientifiques produits par le Ministère; ces documents comprennent 194 cartes. De plus, quelque 1 800 nouveaux dossiers d'exploration minière soumis en vertu de la loi sur les mines ont été rendus publics. En cours d'exercice, la clientèle a commandé 66 400 copies de document.

NEW BRUNSWICK DEPARTMENT OF NATURAL RESOURCES AND ENERGY
MINES DIVISION

The Mines Division is a new entity, formed in 1989 and headed by a Minister of State for Mines, the Honorable E.P. Blanchard, who reports to the Honorable Morris Green, Minister of Natural Resources and Energy. The Division is responsible for the management of the province's mineral resources through a number of acts that cover exploration, development, production and taxation of metallic, non-metallic and structural mineral resources. The organization comprises three branches: Geological Surveys, Mineral Development, and Policy and Planning (p.11).

Geological Surveys Branch

(Director, J.L. Davies)

The Geological Surveys Branch collects, compiles, interprets and disseminates geoscience information pertaining to the province's geology and mineral resources.

Mineral Development Branch

(Director, G.J. Greer)

The Mineral Development Branch consists of four sections: Mineral Development, Mineral Processing, Mine Engineering and Mineral Lands.

The overall goals of the Branch are: 1) to ensure that mineral deposits are developed at an optimum rate consistent with long term income and employment objectives, 2) to enhance the economic viability of marginal mineral deposits, 3) to ensure that inactive or exhausted mines are rehabilitated to a state that avoids on-going costs to the public, 4) to ensure optimum recovery of minerals both in the mining and milling of the ores, and 5) to ensure the highest degree of in-province processing of mineral concentrates.

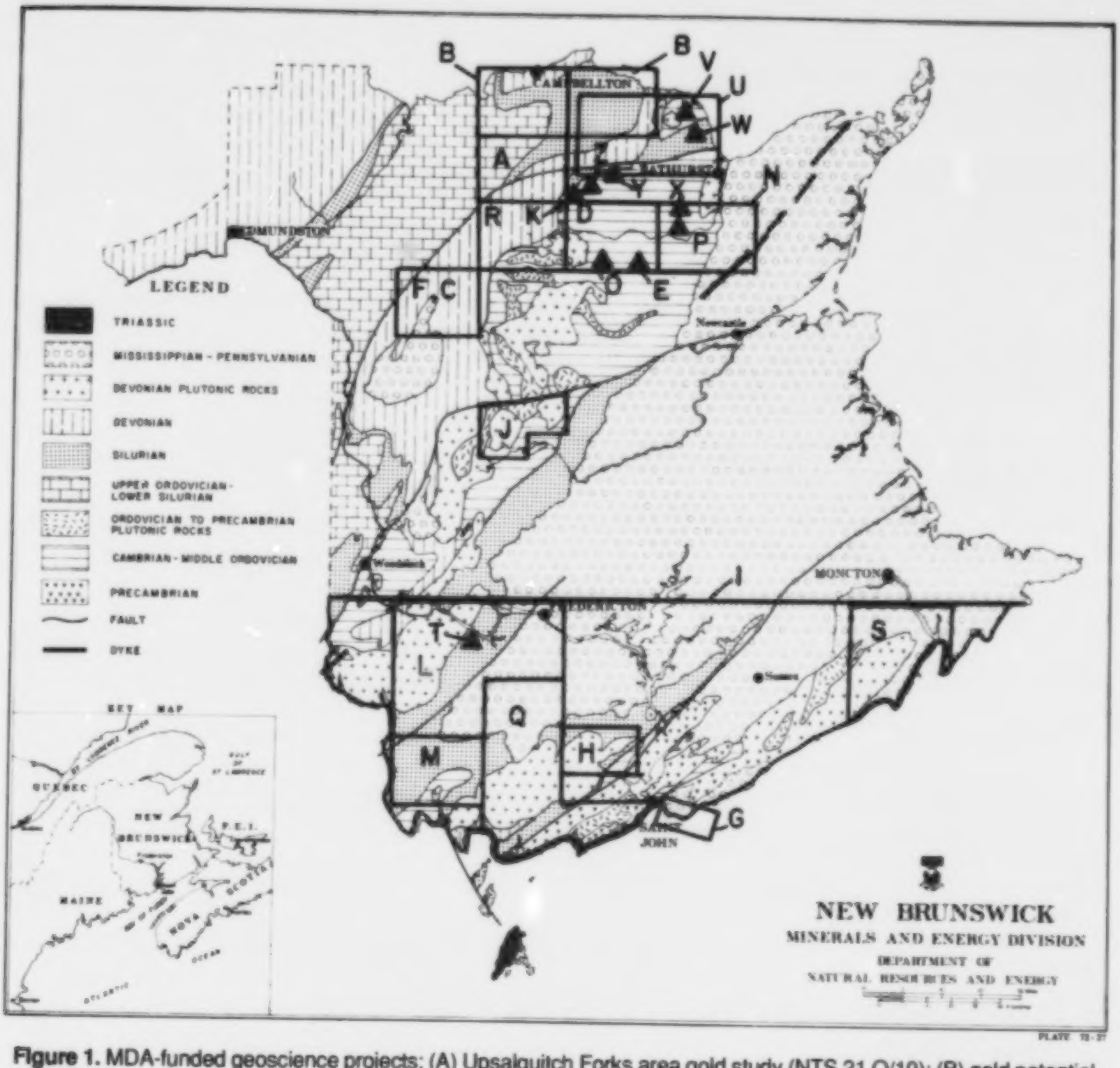
GEOSCIENCE PROGRAMS

Mineral Development Agreement

The Mineral Development Agreement (MDA) between New Brunswick and Canada is now in its sixth (carry-over) year. The amount of funds remaining is only sufficient for contract salaries and printing costs associated with the final reports and maps. In 1989, provincial, so-called "A" Budget, funds were used to carry out a modest field program involving MDA personnel.

Final reports and maps covering the following projects are in preparation:

1. St. George Batholith Project—M.J. McLeod (H, Figure 1)
2. Gold-bearing rocks—Fundy coastal Zone—S.E. Watters (G, Figure 1)
3. The New Brunswick Mineral Occurrence File—D.R.Rose and S.C. Johnson
4. Geology and gold deposits of the Upsalquitch Forks area (NTS 21 O/10)—J. Walker and S.R. McCutcheon (A, Figure 1)
5. Gold deposit potential in the Campbellton–Charlo River area (NTS 21 O/15, O/16)—G.R. Philpott (B, Figure 1)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EDMUNDSTON
F, C
O
E
Newcastle
J
LEGEND
TRIASSIC
MISSISSIPPIAN - PENNSYLVANIAN
DEVONIAN PLUTONIC ROCKS
DEVONIAN
SILURIAN
UPPER ORDOVICIAN - LOWER SILURIAN
ORDOVICIAN TO PRECAMBRIAN PLUTONIC ROCKS
CAMBRIAN - MIDDLE ORDOVICIAN
PRECAMBRIAN
FAULT
DYKE
Woodstock
MONCTON
I
FREDERICTON
T
L
S
Sussex
KEY MAP
QUEBEC
NEW BRUNSWICK
P.E.I.
MAINE
NOVA SCOTIA
Q
M
H
G
SAINT JOHN
NEW BRUNSWICK
MINERALS AND ENERGY DIVISION
DEPARTMENT OF
NATURAL RESOURCES AND ENERGY
PLATE 72-27

Figure 1. MDA-funded geoscience projects: (A) Upsalquitch Forks area gold study (NTS 21 O/10); (B) gold potential of Silurian-Devonian volcanics (NTS 21 O/15, 16); (C) Quaternary geology (NTS 21 O/15, 22 B/1, 2); (D) geocompilation project (NTS 21 O/8); (E) Heath Steele mine structural study; (F) geological mapping (NTS 21 O/3, 4); (G) mapping of gold-bearing rocks, Cape Spencer area; (H) mapping, eastern Saint George Batholity; (I) mapping, western Saint George Batholith; (J) mapping, Burnthill Pluton; (K) Albert Formation study; (L) Stoney Creek oil and gas field study.

Provincially funded geoscience projects: (M) Stratmat deposit study; (N) Key Anacon deposit study; (O) Half Mile Lake Deposity study; (P) Mount Pleasant caldera study; (Q) surficial geology (NTS 21 G/6); (R) amphibolite study in Maramichi Zone.

Properties being explored or developed: (S) Mechanic Settlement platinum; (T) Lae George antimony mine; (U) Alcida-Upsalquitch River belt; (V) Quebec Sturgeon River deposit; (W) Nigadoo base-metal mine; (X) Maliseet (Goodwin Lake) deposit; (Y) Caribou massive sulphide deposit; (Z) Murray Brook deposit.

6. Tin-tungsten-bearing Devonian granites of central New Brunswick—H.E. MacLellan and L.R. Fyffe (J, Figure 1)

7. Geocompilation in the California Lake map area (NTS 21 O/8)—Three–D Geoconsultants, K.D. Whaley and T.G. Mersereau (D, Figure 1)

Meanwhile, field work continued on several other projects in 1988–89. A.G. Pronk and M.A. Parkhill carried on with the 1:50 000 scale regolith mapping and till geochemistry of northern New Brunswick. In 1988, the work involved the Riley Brook map area (21 O/3) (C, Figure 1). The results indicated that ice movement, from west to east and southeast, was guided by the central highland and did not reach the Chaleur Bay area. The 1989 mapping covered the Nepisiguit Lakes (NTS 21 O/7) map area.

R.A. Wilson mapped the bedrock underlying the Riley Brook (NTS 21 O/3) area (F, Figure 1). The supracrustal rocks are interbedded felsic and mafic lavas and tuffs, quartzose sandstone, siltstone and slate of the lower Devonian Tobique Group. Volcanism seems to have been related to an extensional within-plate tectonic regime.

The University of New Brunswick (P.F. Williams and A.L. McAllister) completed the study of the Heath Steele massive sulphide deposits (E, Figure 1) and submitted all the data to the Geological Surveys Branch in April 1989. The project was aimed at identifying additional ore reserves in the mine area. In general, it was concluded that there had been at least five periods of folding, but only the first two were significant in localizing the sulphide deposit.

A contract was awarded to Three–D Geoconsultants to compile the geoscience data for the Nepisiguit Falls (NTS 21 P/5) map area (N, Figure 1). The previous project involving the California Lake map area will be used to pilot a geoscience information system using CARIS, the system that has been officially adopted by the Province of New Brunswick.

Provincial Projects

In Southern New Brunswick, A.A. Ruitenberg and A. Roy started the Pokiok project (NTS 21 J/3, 2, G/14, 15, 11) (L, Figure 1) involving bedrock and regolith mapping of an area underlain by the contact metamorphic aureole of the Pokiok granite pluton. The rocks are potential hosts for tungsten, tin, gold and antimony deposits. The Lake George stibnite mine (T, Figure 1), a potential producer, occurs in these rocks.

Compilation of the geology of the area covered by NTS 21 H and 21 G, at a scale of 1:250 000, (I, Figure 1) is underway. The project is being carried out by A.A. Ruitenberg, M.J. McLeod and S.C. Johnson.

Reports and maps dealing with MDA projects are in the final stages of preparation.

In northern New Brunswick, S.R. McCutcheon and J. Walker began a long-term project on the Antinouri Lake-Nicholas Denys structure (U, Figure 1). The area straddles a thrust boundary between deformed Silurian and Ordovician terranes. Prominent features are the Antinouri Lake and Nicholas Denys granite stocks and the Rocky Brook-Millstream Fault system. There are 80 documented metallic mineral occurrences in the region, including two past zinc-lead-silver producers, *viz.*, the Nigadoo and Keymet Mines (W and V, Figure 1). In recent years, several gold occurrences have been found, including one potential producer, the Alcida deposit of Corona Resources. The aim of the project is to assess the mineral resource potential of the area and to encourage exploration for hidden mineral deposits.

A. Brewer initiated a study of the internal stratigraphy of the Tetagouche volcanic pile. The work entailed a detailed reassessment of the host rock of the mined-out Brunswick No. 6 deposit in the Nepisiguit Falls area (NTS 21 P/5).

R.A. Wilson continued his geological and lithogeochemical investigation of the Tobique Group, a Lower Devonian volcanic-sedimentary assemblage with extensional within-plate tectonic affinities.

M.A. Parkhill mapped the Quaternary geology of the Nepisiguit Lakes area (NTS 21 O/7; R, Figure 1).

In southern New Brunswick, L.R. Fyffe continued his work in the McAdam–St. Croix area (M, Figure 1). He reports that the geology of the area is dominated by the northeasterly trending Norumbega–Fredericton Fault, that in part separates Silurian turbidites and Ordovician pelites. A Devonian biotite monzogranite stock intrudes the supracrustal rocks.

Quaternary geological mapping continued with A.A. Seaman concentrating his efforts in southeastern (NTS 21 H/6, 11, 14) and southwestern (NTS 21 G/1, 2, 7, 10, 11) (O, Figure 1) New Brunswick. M. Foisy and G. Prichonnet began a study of glaciation and deglaciation in the Caledonian Highlands near Hillsborough (NTS 21 H/10, 15) (S, Figure 1)). Preliminary results indicate that the Caledonian Highlands, contrary to earlier interpretations, did support a late-stage ice cap. In general, the orientation of striations appears to be a poor predictor of ice-flow direction at the time of till deposition.

R.R. Irrinki renewed his work on base and precious metal deposits with the compilation of drill hole information and geology in the vicinity of the Lake George antimony mine and the Restigouche and Murray Brook massive sulphide deposits. P. Rennick carried out detailed mapping on the Murray Brook deposit (Z, Figure 1). R.R. Irrinki also laid the ground work for the acquisition of the computer hardware necessary to initiate a digitized geoscience information system using CARIS software.

G. Crouse supervised the first year of the Mineral Exploration Incentive Program (MESP), which is designed to aid prospectors and small exploration companies. Of the 48 projects submitted, 31 were funded for a total cost of $199 738.

Approximately 10 000 m of drill core were collected and storage space for 80 000 m was constructed in Fredericton and Bathurst.

EXPLORATION

Northern New Brunswick

Exploration in New Brunswick was very active in 1988 and 1989. The total number of claims staked in 1988 was nearly 7000, up 53 percent from 1987. The number of claims staked in the period November 1988 through February 1989 was the highest recorded since 1952–53. The renewed interest in base metals is, in part, responsible for this increased activity, although gold exploration continued unabated throughout the province. It is well-known among the exploration fraternity that the Ordovician Tetagouche volcanic complex, in the Bathurst–Newcastle area (A, Figure 2), hosts a large number of base metal, massive sulphide deposits, most found during the period 1952-1975. Some deposits have been mined out but three are presently in production: Brunswick No. 12, Caribou, and Heath Steele (1, 2 and 3, respectively, Figure 2). Late in 1989, gossan overlying the Murray Brook deposit (4, Figure 2) will be exploited for its gold and silver content; the Restigouche deposit (F, Figure 2) is undergoing an environmental impact assessment. The Half Mile Lake and Captain NE deposits (6 and 7, Figure 2) are considered to be potential producers. The exciting possibility of discovering another Brunswick No. 12 orebody is a strong incentive for exploration in this region.

The Tobique–Chaleur zone (B, Figure 2) received the most attention in the search for gold. Features of interest are gold-bearing, fossil epithermal systems in Silurian and Devonian volcanic and sedimentary rocks with or without mafic and felsic intrusions. Several late Paleozoic epithermal systems have also been discovered in the Tetagouche volcanic complex.

The main companies involved in northern New Brunswick are: Noranda Exploration Company, Ltd; Brunswick Mining and Smelting Corporation Limited; Corona Corporation; Acadia Mineral Ventures; Falconbridge Limited; Seabright Explorations Inc.; Granges Exploration Limited; Stratabound Minerals Corporation; NovaGold Resources Inc.; Cominco Limited; and Rio Algom Exploration Inc.

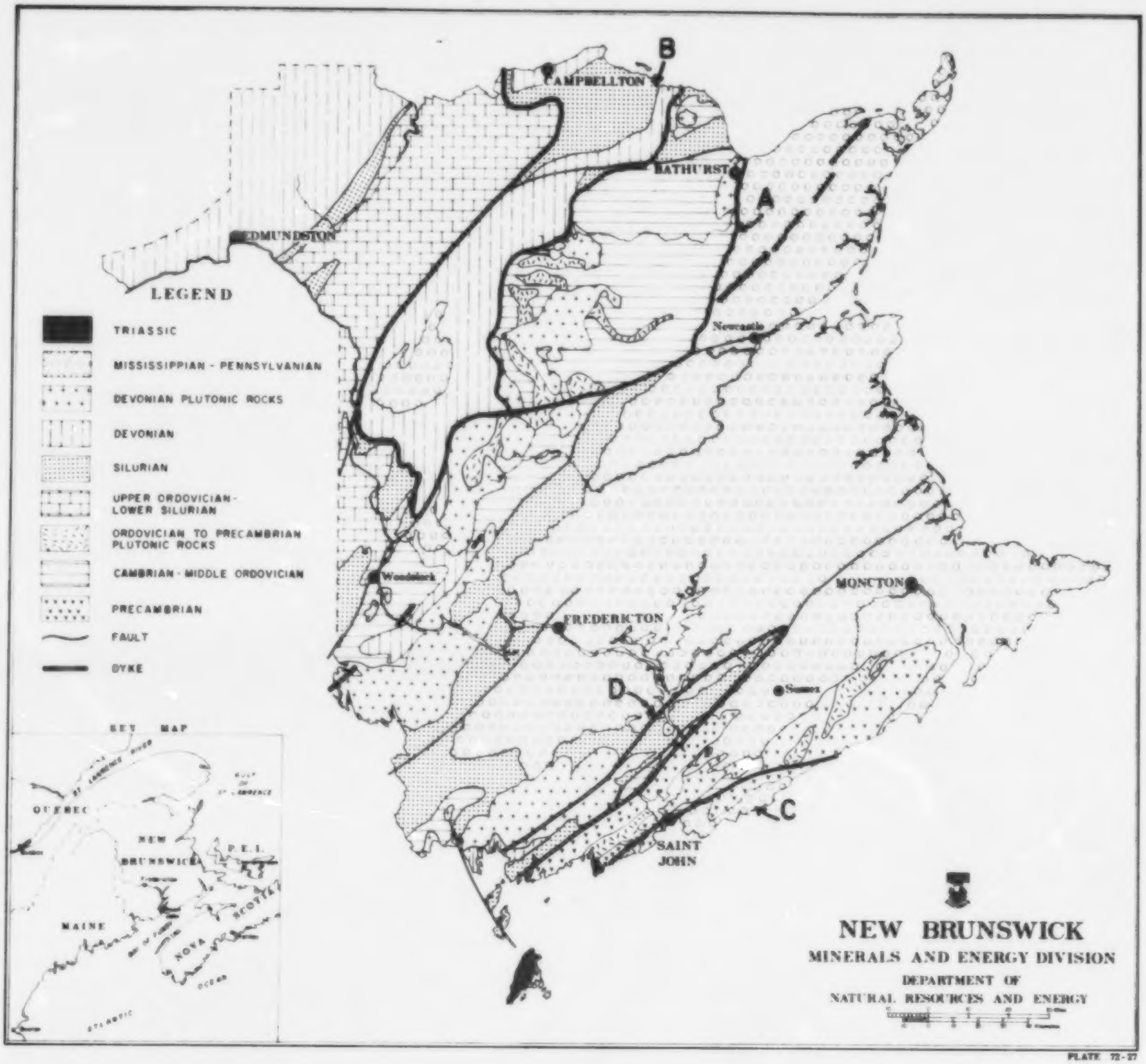

B
CAMPBELLTON
BATHURST
A
EDMUNDSTON
Newcastle
LEGEND
TRIASSIC
MISSISSIPPIAN - PENNSYLVANIAN
DEVONIAN PLUTONIC ROCKS
DEVONIAN
SILURIAN
UPPER ORDOVICIAN - LOWER SILURIAN
ORDOVICIAN TO PRECAMBRIAN PLUTONIC ROCKS
CAMBRIAN - MIDDLE ORDOVICIAN
PRECAMBRIAN
FAULT
DYKE
Woodstock
FREDERICTON
MONCTON
D
Sussex
C
SAINT JOHN
KEY MAP
ST. LAWRENCE RIVER
GULF OF ST. LAWRENCE
QUEBEC
NEW BRUNSWICK
P.E.I.
MAINE
NOVA SCOTIA
ATLANTIC OCEAN
NEW BRUNSWICK
MINERALS AND ENERGY DIVISION
DEPARTMENT OF
NATURAL RESOURCES AND ENERGY
PLATE 72-27

Figure 2. MINERAL EXPLORATION 1988

A. Tetagouche volcanic complex (Bathurst - Newcastle area)
B. Tobique - Chaleur zone
C. Bay of Fundy gold belt
D. Annidale - Nerepis belt

In southern New Brunswick, gold exploration was most active in the Hercynian conjugate thrust zone centred in Saint John (Bay of Fundy gold belt) (C, Figure 2)). The gold deposits in this terrane occur in thrust slices of Precambrian volcanic and intrusive rocks and Paleozoic sedimentary rocks.

The Gordex Mine, the only gold producer in the province, encountered difficulties and was forced to shut down in 1989. In 1988, Gordex had reported a new find 1 km north of the mine. A drill hole intersected 16.5 m grading 19.5 g/t Au. The new discovery is being investigated by Cambior and Gordex. There was also an increased interest in the Nerepis-Annidale belt (D, Figure 2) where several gold prospects have been found.

The main participants in southern New Brunswick are: Gordex Minerals Limited, Cambior Inc., Mispec Resources Inc., Corona Resources, Brunex Gold Resources Limited, Cuvier Mines Inc., Neptune Resources Corporation, Atlantic Goldfields Inc., Goldfluor Exploration Limited, Kimbauri Gold Corporation, Lombard Consolidated Resources Inc., Lac Minerals Limited, Costigan Gold Corporation, Brunswick Mining and Smelting Corporation Limited, Grand Empire Exploration Limited, BP Resources Canada Limited, Dominion Exploreres Inc., and PGE Resources.

NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY

GEOSCIENCE ACTIVITIES

A wide variety of geoscience activities are being undertaken by the geological staff of 39 in the Department. This work has many benefits to other government agencies, schools and teachers, the tourist industry, universities and the general public. The products of the various geoscience activities are used, for example, to locate areas of mineral potential for land-use planners and others, to provide detailed information about mineral deposits for exploration companies, and to encourage residents and visitors to use the geological features of the province as destination points.

ORGANIZATION OF THE DEPARTMENT

The Nova Scotia Department of Mines and Energy has a broad mandate to encourage research and development leading to additional mineral and energy resources, and promoting their orderly regulation and use. In fulfilling this mandate, the Department is divided into the Mines and Minerals Branch and the Energy Branch. Three divisions in the Department, the Mineral Resources and Mineral Development divisions of the Mines and Minerals Branch and Energy Resources Division of the Energy Branch, administer geoscience projects.

ENCOURAGING THE MINERAL INDUSTRY

The work of the two branches encourages companies and individuals to explore for energy and mineral resources in Nova Scotia. The Department promotes these resources through various departmental and mineral development strategies. Between 1984 and 1989, the Canada–Nova Scotia Mineral Development Agreement (CNSMDA) spent $26.9 million—$16.1 million from Canada and $10.8 million from Nova Scotia—to strengthen and promote the province's mineral and energy resources. The five programs of the CNSMDA, Geoscience, Mineral Development, Mineral Technology and Research, Mineral Investment Stimulation, and Public Information, were developed for co-ordinated but parallel delivery by Energy, Mines and Resources Canada (EMR) and the Department. Almost all of the projects described here were funded through the CNSMDA.

Mineral Resources and Mineral Deposits Studies

Both metallic and non-metallic mineral deposits are being investigated to increase the knowledge and understanding of mineral resources in Nova Scotia. The CNSMDA has supported additional product-use and marketing research for many of the nonmetallic mineral investigations. These projects were initiated by the Department, the Canadian Centre for Minerals and Energy Testing (CANMET), of EMR, and the Mineral Policy Sector, of EMR.

Non-metallic Minerals. Industrial minerals and construction materials are the principal mineral products from the province; they were valued at more than $223 million in 1988. To support and enhance this part of the mining sector, six projects were begun, under the CNSMDA, to inventory and describe resources of aggregates, gypsum and anhydrite, building stone, diatomaceous earth, fillers and extenders, and various other commodities. Through the winter of 1988, colour brochures of various industrial mineral commodities were prepared to promote Nova Scotia's resources for an important international meeting in Boston.

Additional sources of aggregate are being sought for northern Nova Scotia and for the Halifax–Dartmouth area. In the northern part of the province, the work of the project has resulted in the definition of additional aggregate sources in kames, eskers, post-glacial alluvial fan deposits and residuum. The Halifax–Dartmouth area has the largest market for aggregates and the greatest potential for land-use conflict. The staff of the project are attempting to locate bedrock areas where crushed stone aggregate projects might be located.

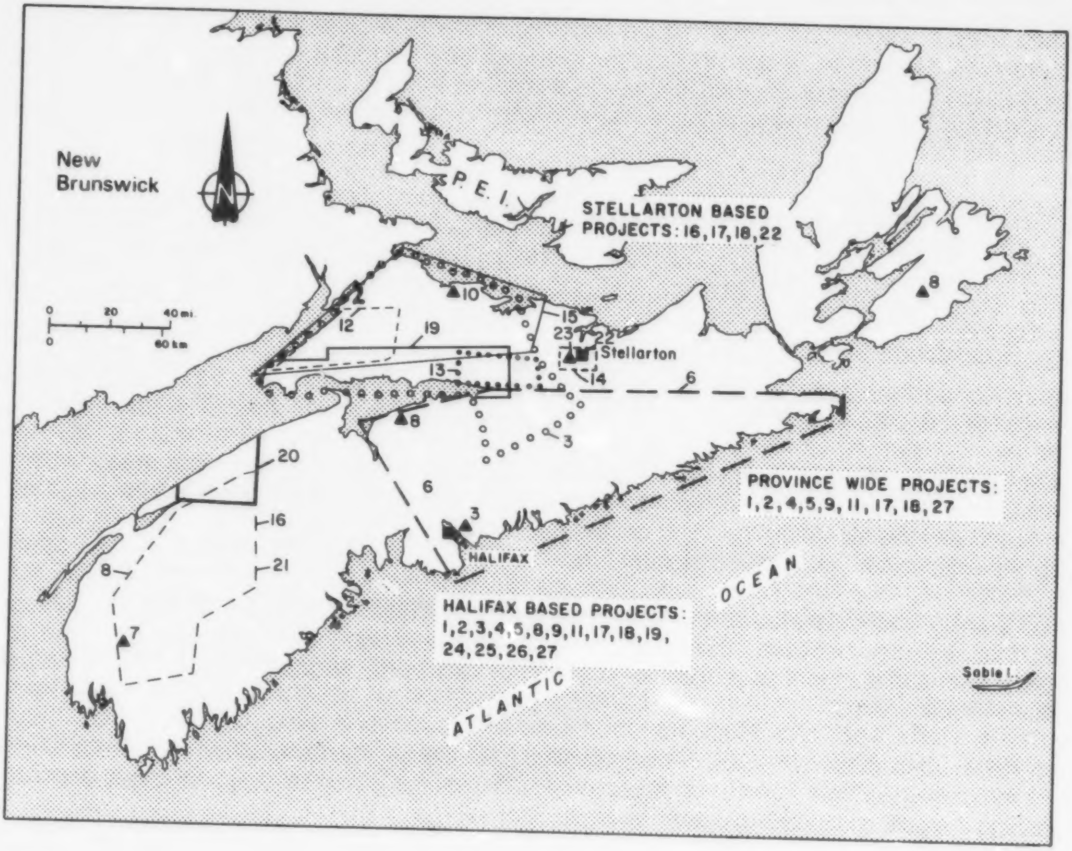
Gypsum and anhydrite have long been important mineral commodities in the province. The work of this study has resulted in a comprehensive inventory of gypsum and anhydrite, and in new uses for the commodities. Diamond drilling, extensive field work and examination of drill core have defined areas in the province with high quality and reasonable quantities of gypsum and anhydrite. Although 10 times more gypsum than anhydrite is mined in Nova Scotia, the reserves of anhydrite are estimated to be billions of tonnes. Anhydrite is being used in various types of experimental plasters. A full scale test is proceeding in one of the Cape Breton Development Corporation's mines to test the feasibility of using anhydrite as a cement for mine wall support.

With the restoration of Province House (the legislature), attention has been focussed on the building stone resources of the province. Four sandstone, two granite and two marble deposits have been drilled to confirm rock quality and to estimate total resources. A new catalogue of building stone, with samples and technical information about each, has been published and is now available.

Several projects are examining the possibility of developing other non-metallic resources for industrial uses—diatomaceous earth, limestone and marble. Work on the Diatomaceous Earth Project has resulted in the description of the quality and quantity of all large deposits in the province. Beginning with a market survey of local needs, the Fillers and Extenders Project has focussed on the large deposits of high quality limestone and marble in Cape Breton. Another project, Various Commodities, was initiated to update and increase the data base for other industrial mineral commodities that occur throughout Nova Scotia. Silica, limestone and dolomite resources are currently being investigated. Near Yarmouth, silica and garnet deposits were examined, mapped and drilled. Other commodities that are being investigated for uses and markets include mica, titanium-rich sands, talc, and by-products of mining operations such as topaz from the East Kemptville tin mine.

The salt deposit at the Pugwash Mine of the Canadian Salt Company has provided an opportunity to understand the stratigraphy and structure of the deposit and the method of formation. An outgrowth of the research has been assistance to the company in developing a new decline to another production level.

Metallic Minerals. Interest in Nova Scotia gold deposits has provided the impetus for further research into the detailed geology of specific gold deposits (Forest Hill, Caribou, Goldenville, Beaver Dam and Tangier). Investigations of the stratigraphy, structure and metamorphism of the Meguma Group host rocks, and the ore forming solutions and plutonism are continuing. Fluid inclusion work has shown that the main fluid was a low salinity, water-carbon dioxide brine under 200 to 300 kPa of pressure. The ore forming event took place about 368 Ma.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STELLARTON BASED PROJECTS: 16, 17, 18, 22
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Stellarton
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HALIFAX
PROVINCE WIDE PROJECTS: 1, 2, 4, 5, 9, 11, 17, 18, 27
HALIFAX BASED PROJECTS: 1, 2, 3, 4, 5, 8, 9, 11, 17, 18, 19, 24, 25, 26, 27
OCEAN
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GEOSCIENCE ACTIVITIES IN THE NOVA SCOTIA DEPARTMENT OF MINES AND ENERGY, 1988-1989

Mineral Resources Studies

1. Industrial Minerals Investigations *
2. Gypsum/Anhydrite Project *
3. Aggregate Resources Project *
4. Building Stone Project *
5. Various Commodities Project *
6. Meguma Gold Project *
7. East Kemptville Tin Project *
8. Metallic Mineral Occurrences Project *
9. Metallogenic Map Project *
10. Pugwash Salt Deposit Project *

Energy Resources Investigations

11. Onshore Petroleum Source Rock Identification Project *
12. Seismic Survey and Coal Resources of the Cumberland Basin
13. Debert-Kemptown Basin Project
14. Stellarton Basin Project

Sedimentary Basins-Regional Mapping

15. Cumberland Basin Project *
16. South Mountain Batholith Project *

Geochemistry and Quaternary Studies

17. Regional Reconnaissance Geochemical Project *
18. Geochemical Atlas Project *
19. Stream Sediments and Catchment Basins Project *
20. Quaternary Mapping Project *
21. South Mountain Batholith Pleistocene Project *

Services to Industry and the Public

22. Stellarton -- Regional Office and Exploration Monitoring
23. Core Library *
24. Coal Exploration Database *
25. Mineral Inventory Database Project *
26. Land Use Policy Development Project *
27. Education and Public Awareness Program *

* Indicates partial or complete funding from the Canada-Nova Scotia Mineral Development Agreement

Figure 1. Locations and types of geoscience projects undertaken by the Nova Scotia Department of Mines and Energy.

Base metal deposits and occurrences at Yava and Sterling on Cape Breton Island, near Walton, and in the East Kemptville region are becoming increasingly important as metal prices rise. Many polymetallic occurrences are located near the East Kemptville tin deposit and are associated with major shear zones. Petrographic and chemical studies of these deposits and their relationship to deformational events are the important parts of the work.

The Metallotectonic Map Project combines data from mineral deposit investigations and regional mapping for the preparation of thematic maps linking metallogeny and plate tectonics. Several syntheses of Appalachian terrane accretion were prepared for external publication. These data provide a large scale, plate tectonic context for mineral resource evaluations in Nova Scotia.

Energy Resources Investigations

The search for additional coal and for oil and natural gas resources continues. The investigations include source rock identification, seismic surveys and sedimentological studies of the coal strata.

Onshore Petroleum Source Rock Identification Project. The Carboniferous rocks of Nova Scotia are potential source rocks for petroleum and natural gas. With several oil seeps in the western part of Cape Breton Island and the recent discovery of natural gas near the Minas Basin, the Department has decided to study the organic content, organic type and thermal maturity of potential source rocks.

Seismic Survey and Coal Resources of the Cumberland Basin. During 1988, 60 line kilometres of seismic data, collected between 1984 and 1987, were reviewed and interpreted. The data have allowed geologists and exploration companies to understand the basin structure and architecture and the correlation of coal seams.

Debert–Kemptown Basin Project. A long block of Late Carboniferous coal-bearing strata is exposed south of the Cobequid Fault in northern Nova Scotia. The area has had several coal mines and this study is assessing the coal resources available for development.

Coal Exploration and Development. The Stellarton Basin is an area of major coal resources in north-central Nova Scotia, created during the Late Carboniferous as a pull-apart basin. The Department and the Geological Survey of Canada have been mapping the sedimentology and stratigraphy of the basin during the CNSMDA. The results have defined the environments of deposition of basin rocks and the locations of minable coals. Work from this project has benefitted the new coal mine development project at Stellarton.

In the Sydney coalfield, a sedimentological study is determining the controls that a lacustrine environment exerted on the deposition of the Harbour Seam in the Donkin Resource Block.

Regional Mapping

The Department has been progressively mapping the mineral resources and bed-rock geology of the province at a scale of 1:50 000 since the first federal-provincial mineral agreement in 1974. Many of the projects that have contributed to this wealth of information have a specialized purpose beyond just areal mapping.

Cumberland Basin Project. Field work for this study of the stratigraphy, sedimentology and mineral resources in northern Nova Scotia was completed in 1988. During the early part of 1989, over 90 geological maps, at a scale of 1:10 000, were released in open file format. Final, 1:50 000 scale, maps are now being prepared.

South Mountain Batholith Project. The entire South Mountain Batholith (SMB) has been mapped at a scale of 1:50 000. The batholith is divided into eight rock types, based on mineralogy and texture. Several discrete plutons were defined within the SMB. The work on the project has resulted in three published geological maps, four open file maps and seven maps in preparation.

Geochemistry and Quaternary Studies

A continuing part of the department's assistance to the mineral exploration industry has been the production of maps and reports describing the surficial deposits of the province, their geochemistry and stream sediment and water geochemistry. Eventually, all of the geochemical data will be published as part of the "Nova Scotia Geochemical Atlas".

Regional Reconnaissance Geochemical Project. Stream sediments were sampled in northern Nova Scotia and Cape Breton Island during the 1986 and 1987 field seasons. This large mass of data, coupled with previous geochemical surveys, will form the data base for half of the province in the "Nova Scotia Geochemical Atlas". Tables of analyses for stream sediment and water samples, computer-generated plots of gold content of heavy fractions, and 1:250 000 scale location maps of the 1986 and 1987 surveys are in preparation for open file release.

Geochemical Atlas Project. The Atlas project is an important undertaking that brings together a wealth of geochemical data. As the project progresses, releases of data are planned. In early 1990, an open file report that summarizes geochemical surveys from 1971 to 1987, will be released. In addition, histograms and symbol-density plots for 12 elements from the 1982-83 survey of NTS map area 11 E will be published.

Specialized Geochemical Studies. Co-operative work between the Geological Survey of Canada (GSC) and the Department has produced a catchment basin analysis of stream sediment geochemistry in the Cobequid Highlands, northern Nova Scotia. The results of the study will be published by the GSC.

In the eastern part of the Meguma zone, a multi-media geochemical survey is aiding gold exploration. Analyses of lake sediment samples, biogeochemical samples, and stream sediment and water samples has outlined interesting gold anomalies. Stream sediment gold analyses show a prominent northwest-trending feature that overprints the Antigonish Highlands and the Saint Marys Graben. Locally, gold is found in varying abundance in the tills.

South Mountain Batholith Pleistocene Survey. Operating in tandem with the bedrock mapping of the SMB is the Pleistocene deposits survey. All of the mapping is complete. Over 2100 till samples were collected and analyzed for 18 elements. Four surficial maps have been published, three are now on open file and eight are in preparation. Results of this work will be used compiling data for the "Nova Scotia Geochemical Atlas".

Quaternary Mapping Project. After completion of surficial mapping in the Annapolis Valley during 1988, all of the work on this project has been directed toward the compilation of a 1:500 000 scale map of Quaternary deposits in Nova Scotia. Work on the compilation of the map is about 85 percent complete.

Services to Industry and the Public

The Department offers a wide variety of services, information and assistance to individual prospectors, exploration companies, government agencies and the general public.

Regional Office, Core Library and Exploration Monitoring. The Department maintains a regional office at Stellarton, with a library, core storage facilities and core library. The Stellarton Core Library has four buildings and houses 500 000 m of diamond-drill core. Complete facilities are available at the library for the examination and study of the core. Private sector exploration activities are monitored from this office.

Data Bases, Information and Libraries. Large data bases, including GEOSCAN, are available for use. The information covers bibliographic data, mineral occurrences, drill hole information and coal geology. The Department maintains technical libraries in Stellarton and Halifax. The holdings consist of over 7000 maps, 4200 assessment reports, 600 theses, 200 periodicals, journals and trade magazines, several hundred text books, all GSC and EMR publications, and selected publications from adjacent states and provinces. A thorough review and update of the metallic mineral occurrences data base has been completed during 1988 and 1989.

Mineral Land Use Policy Development Project. This project channels mineral resource information to provincial and municipal planning groups. It was created because the Department has defined a need for a more judicious selection of land, with mineral potential, for multiple and sequential use. During the last several years, Mineral Resource Land Use maps, at 1:50 000 scale, have been completed for Halifax, Hants, Kings and Cape Breton counties.

Education and Public Awareness Program. The Education and Public Awareness Program promotes an understanding of the mineral resources, geology and mineral industry of Nova Scotia. The users of this information are visitors and residents, students and teachers, exploration companies and government agencies. Prospecting courses, displays, seminars, interpretive walks, publications and educational materials are products of the program. During 1989, the second edition of the "Geological Highway Map of Nova Scotia" was published.

CONCLUSION

The geoscience projects described here are supporting and encouraging mineral exploration and strengthening the province's mineral industry. The steady production growth of industrial minerals, coal, aggregates, base metals and tin has encouraged the exploration and mining sectors. With its diverse geology, deep-water ports, strong mining tradition and willing labour force, Nova Scotia looks forward to a stable and diversified mineral industry.

NEWFOUNDLAND AND LABRADOR DEPARTMENT OF MINES AND ENERGY GEOLOGICAL SURVEY BRANCH

INTRODUCTION

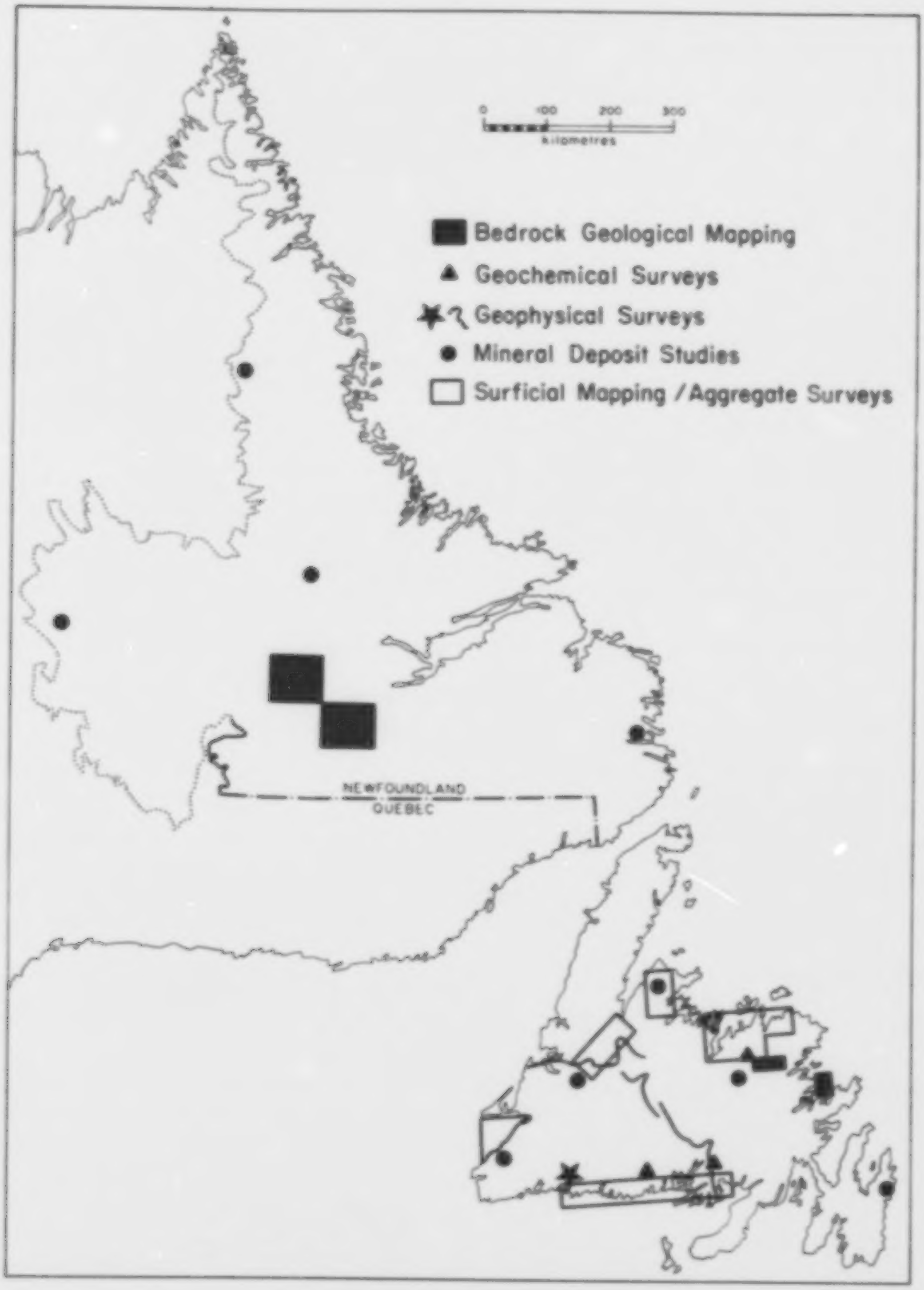
The Newfoundland and Labrador Department of Mines and Energy underwent a major reorganization in 1988–89. Major elements of the reorganization involved the combining of the formerly separate departments of Mines and Energy and the creation of two branches in the Mines Sector. These branches are the Mineral Resource Management Branch, responsible for administration of mineral legislation and mineral economics, and a Geological Survey Branch, essentially replacing the old Mineral Development Division. The Geological Survey Branch is responsible for the province's geoscientific data base.

GEOLOGICAL SURVEY BRANCH

The Geological Survey Branch continued projects in bedrock geological mapping, geochemistry, geophysics, mineral deposit studies, surficial mapping and information services in 1989. This work represents the continuation of a long-term program initiated in the mid-1970s. The program has been greatly assisted by the 1984–1989 Canada–Newfoundland Mineral Development Agreement for the past five years. The agreement ended March 31,1989, although some funds for publication of results and other office work were provided in 1989–90. The province provided an additional $1 million this year in A-base funds; this enabled the Branch to carry out a field program, operating at about half the level experienced at the peak of the Mineral Development Agreement.

Geological Mapping Sections

The Geological Survey Branch carried out five bedrock geological mapping projects in 1989. In Labrador, Dick Wardle and Andy Thomas completed two 1:100 000 scale map sheets in the central part of Grenville Province, one in the Minipi River area, the other in the adjacent Wilson Lake area. In Newfoundland, Sean O'Brien and Pat O'Neill continued 1:50 000 scale mapping in the Eastport and Gander areas, respectively, while Brian O'Brien initiated a new project in central Notre Dame Bay. The Notre Dame Bay work is aimed


0
100
200
300
kilometres
Bedrock Geological Mapping
Geochemical Surveys
Geophysical Surveys
Mineral Deposit Studies
Surficial Mapping / Aggregate Surveys
NEWFOUNDLAND
QUEBEC

GEOLOGICAL SURVEY BRANCH
1989 FIELD PROGRAM

at describing the stratigraphy and structure, and the production of new 1:50 000 scale maps of the volcano-stratigraphic sequences which host the many base metal deposits of the area.

The remaining geologists in the bedrock mapping sections remained in the office, working on reports and maps summarizing the results of the past four years field work. Two profitable exchange visits were also arranged; two geologists from the Labrador Mapping Section visited the Finnish Geological Survey, and two from the Newfoundland Section visited areas in northern England wih the British Geological Survey. Return visits from these organization to examine similar rocks in Labrador and Newfoundland are being arranged for 1990.

Geochemistry–Geophysics Section

Regional, lake sediment geochemistry surveys were completed for Newfoundland and Labrador in 1987. The archived lake sediment samples are now being analyzed for gold and other elements not included in the initial work. Open file releases of the results of these analyses initiated a great deal of interest and led to considerable new staking in central Newfoundland in 1989. Reanalysis of the archived lake sediment samples is now about half complete for Newfoundland and about 10 percent complete for Labrador.

John McConnell continued his detailed geochemical studies of areas of known gold mineralization and anomalous regional lake sediments, with the objective of evaluating geochemical methods for following up the regional data. His work this year concentrated on the south coast of Newfoundland, where gold anomalies occur in areas with little overburden.

Large areas of Newfoundland were covered by airborne gradiometer and gamma ray surveys under the 1984–89 Canada–Newfoundland Mineral Development Agreement. This data has been acquired in digital form from the Geological Survey of Canada, and is being interpreted to assist bedrock mapping projects. The Branch's geophysicist, Gerry Kilfoil, also carried out ground magnetic and VLF-EM surveys in support of bedrock and surficial mapping projects, and assisted with seismic surveys associated with the Lithoprobe East transect across Newfoundland.

The geochemical laboratory completed major and trace element analysis on some 2150 rock samples during 1989. Another 2500 samples, mainly lake sediments, were analyzed under contract.

The Geochemistry–Geophysics Section initiated a new project in image enhancement and spatial analysis of geoscientific data in 1989. The system presently consists of PCI image analysis and TYDAC SPANS spatial analysis software mounted on a 386-type microcomputer. It is being used to optimize the interpretation of geological, geochemical and geophysical data sets in selected areas of the province.

Mineral Deposits Section

The Mineral Deposits Section is responsible for metallogenic studies, industrial mineral assessment and mineral inventory. Two metallogenic projects were in the field in 1989. John Hayes carried out a geological-lithogeochemical study of alteration zones on the eastern Avalon Peninsula; these zones host the pyrophyllite mine at Manuels, and small gold occurrences. Dave Evans began a study of gold mineralization in north-central Newfoundland, concentrating initially on occurrences in and west of the Gander River ultrabasic belt. Reports on the metallogeny of mineral deposits associated with granitoids are in preparation. These reports will summarize the results of two projects carried out under the Canada–Newfoundalnd Mineral Development Agreement.

Jamie Meyer continued his assessment of industrial mineral resources in Labrador, concentrating this year on graphite occurrences in the Labrador Trough. Jamie also initiated an assessment of slate deposits in eastern Newfoundland. Our other industrial mineral geologist, Ambrose Howse, spent most of the 1989 season in the office, completing reports on barite, limestone and marble assessments carried out over the past four years.

The mineral inventory project, under the direction of Cyril O'Driscoll, completed preparation of 1:250 000 scale mineral occurrence maps for Newfoundland, and continued with the Labrador inventory. Computerization of mineral occurrence data continued.

Terrain Sciences Section

The Terrain Sciences Section is responsible for surficial mapping, mineral aggregate assessment, and nearshore mineral potential assessment. Three Quaternary mapping projects were carried out in 1989. David Liverman continued his mapping on the Baie Verte Peninsula, where gold exploration is creating an increasing demand for Quaternary data. Dave Proudfoot continued 1:50 000 Quaternary mapping in the area northeast of Bay d'Espoir. Martin Batterson completed earlier work in the Carboniferous Deer Lake Basin, and continued preparation of reports on his work in east-central Labrador over the past four years.

Two projects were carried out in the mineral aggregate area. Dan Bragg initiated an assessment of potential bedrock aggregate sites along the south coast, with a view to identifying resources for possible export. Gerry Ricketts carried out an assessment of surficial aggregate resources in the Gander area of central Newfoundland.

Work on assessment of the mineral potential of the nearshore has been carried out by the Centre for Cold Ocean Resources Engineering (C–CORE) at Memorial University, under contract to the Geological Survey Branch. In 1989, the Centre completed a regional assessment of the potential of the nearshore for marine placer deposits, using available data on possible onshore source rocks and transportation corridors. A more detailed geochemical study of samples collected from the Port au Port and St. George's Bay areas is also underway.

Publications and Information Section

Results of the 1989 program will be released in preliminary form at the annual review of activities in November, in Current Research (Report 90–1), and in individual project reports.

INDIAN AND NORTHERN AFFAIRS CANADA
NORTHWEST TERRITORIES GEOLOGY DIVISION

During 1989, the NWT Geology Division carried on its provincial-type responsibilities. These included: monitoring mining, mineral exploration and geological developments; reviewing mineral claim and Prospecting Permit technical assessment reports, and monitoring diamond drilling as required under the Canada Mining Regulations; conducting mineral deposit studies and geological mapping, and collecting material and information to be made available through the Mineral Exploration Archive and the C.C. Lord Core Library.

Public releases during 1988 included 12 open file maps or reports, volume three of "Contributions to the Geology of NWT", and previews and overviews of mining, exploration and geological research for 1988. A list of all Geology Division publications is available from the Geology Division in Yellowknife. This list is regularly updated. Publications are also indexed in GEOSCAN, but this listing is updated only once a year.

Geological studies were supported under seven contracts, one to a consulting company, four to Canadian and one to an American university; these projects are listed in Table 1. In addition, the NWT Geology Division provided technical direction, logistical support and, in some cases, equipment, supplies and field personnel to assist the Canada–Northwest Territories Mineral Development Agreement NWT (MDA) projects described in Table 2. These projects were co-ordinated with the Geological Survey of Canada (GSC) MDA projects listed in Table 3.

Val Jackson (Project Geologist) completed mapping in the Russell–Slemon lakes area (85 O/4), and worked in parts of the Kathawachaga Lake area (76 L).

Other geological staff continued with geological studies on various topics, but the technical support requirements of the NWT MDA severely restricted progress on these. Staff turnover during 1988, specifically the departure of 25 percent of the division's senior staff caused major difficulties. Employment of a native geologist in a training position ameliorated some of the staff shortage.

A proposal for a Lithoprobe transect in the Great Slave Lake area (GSLT) was prepared and presented to the Lithoprobe Secretariat. GSLT was not funded but it will be resubmitted for the next round of Lithoprobe surveys.

The Division also suffered from belt tightening, losing eight percent of its permanent staff positions to austerity in 1989.

Negotiations to devolve responsibility for non-renewable resources to the Government of the Northwest Territories continued. Recently, the Government of the Northwest Territories established its Department of Energy, Mines and Petroleum Resources into which the Minerals Directorate, including the NWT Geology and Mining Lands divisions, would be fitted. This devolution should be complete by 1995, but could be completed much sooner.

The Canada–Northwest Territories Mineral Development Agreement progressed satisfactorily on most fronts in 1988 and 1989. One project, on the Yellowknife Volcanic Belt, was delayed by the transfer of the officer in charge to a District Geologist position. A replacement with considerable experience in the volcanic belt was hired in 1989.

Expenditures on the MDA Geoscience Program administered by the NWT government are included in the table showing expenditures by INAC for A-base NWT Geology Division programs (see p.28). Only the total expenditure for the Geological Survey of Canada administered portion of the MDA Geoscience Program is included. Considerable operational savings have been effected by co-ordination of logistics and technical field support between MDA and A-base programs, and between programs administered by NWT Geology Division, the NWT MDA and the GSC.

This co-operation also extends to publications. Brief reports on some GSC work, all MDA work and work sponsored by the NWT Geology Division were presented in the Mineral Exploration Overview for 1989.

Results of the various MDA, NWT Geology Division and many GSC programs were also reported at the annual Geoscience Forum in 1988 and 1989. The 1989 meeting was the 17th annual forum. These meetings take place in Yellowknife during the first week of December.

TABLE 1. NWT GEOLOGY PROJECTS 1989

PROJECT	DESCRIPTION	GEOLOGIST IN CHARGE (Liaison)
1.INDIN VOLCANIC BELT	Structural and stratigraphic studies to fit the numerous and varied gold deposits of this belt into the geology of the area and to elucidate the relations between the volcanic and sedimentary successions.	Dr. J. Morgan (Dr. D. Atkinson)
2.YELLOWKNIFE VOLCANIC BELT	Structural and stratigraphic studies to fit the numerous and varied gold deposits of this belt into the geology of the area and to elucidate the relations between the volcanic and sedimentary successions.	H. Falck (Dr. D. Atkinson)

3.CARP LAKE (85 P)	Mapping (1:50 000) of an area of complex geology with potential for various gold, silver and base metal deposits.	Dr. M. Stubbly (Dr. D. Atkinson)
4.ARCTIC SOUND (76 N) MARA RIVER (76 K)	Mapping (1:50 000) of the lower Hood–James River area, an area that contains abundant turbidite sediments hosting Lupin-type (banded iron formation) gold deposits.	R. Johnstone (V. Jackson)
5.RIDEOUT ISLAND (76 O)	Mapping (1:50 000) of an area with abundant volcanic rocks with native silver, volcanogenic massive sulphide and gold potential.	J. Gebert (Dr. W.A. Gibbins)
6.TAVANI (55 K)	Mapping (1:50 000) of areas with abundant, presumably Archean, volcanic rocks (Rankin–Ennadai volcanic belt).	Dr. S. Goff (Dr. W.A. Padgham)
7.HEPBURN ISLAND (76 M) KATHAWACHAGA LAKE (76 L)	Mapping (1:50 000 and 1:25 000) of granite-greenstone terrains.	V. Jackson
8.SLEMON LAKE (85 O/4)	Mapping (1:30 000) of an area of volcanic rocks and sediments with BIF pyrite-pyrrhotite gold deposits in sediments.	V. Jackson
9.SLAVE PROVINCE (86 G)	Mapping and collecting material for geochronology and petrological studies of gneissic terrain (pre-3.5 Ga).	Dr. W.A. Padgham Dr. S.A. Bowring
10.REID LAKE (85 I/11)	Studies of turbidite-hosted mineral deposits in the western part of the Yellowknife sedimentary domain.	J.B. Seaton
11.ELU INLET VOLCANIC VOLCANIC BELT (77 A)	Mapping (1:50 000) of a volcanic belt in the northeast Slave Structural Province.	Dr. W.A. Gibbins

1–6 are Canada–NWT MDA projects, 7–11 are NWT Geology Division projects

TABLE 2. GEOLOGICAL CONTRACTS 1989-90

ADVISOR, UNIVERSITY	DESCRIPTION	(STUDENT, DEGREE)
1. J.A. Donaldson, Carleton	Extend detailed studies of the volcanic and sedimentary rocks in the Giant Section and relate the results of this work to other units in the Yellowknife volcanic belt (85 J/8, 9).	(Lindsay Hall, BSc)
2. Environmental Consulting Services, Alberta	Reconnoitre surficial geology of the Yellowknife River Basin and map and study Quaternary sediments along the Arctic coast of the NWT—Kathawachaga Lake to Elu Inlet.	(Dan Kerr, PhD)
3. S.A. Bowring, Washington University of St. Louis	Geochronological studies in the Slave Province and mapping related to geochronological sampling; this work has recently (1989) identified the oldest rocks in the world (circa 3.975 Ga).	(Clark Isachsen, PhD)
4. H. Helmstaedt, Queen's	Map and study sheeted dyke complexes in KAM Group, Yellowknife volcanic belt (85 J/9).	

5. A. Lalonde, Ottawa	Study gold-deposit-hosting turbidite successions in lower James River and Hood River areas (76 K, 76 N).	(Susan Schaan, MSc)
6. R.S. James, Laurentian	Study supracrustal rocks that have gold showings in in the Tehek Lake area (56 D/NW, Keewatin District).	(Allen Armitage, PhD)
7. W.K. Fyson, Ottawa	Study structure of supracrustal rocks in the Slave Province and relate the structural succession to gold metallogeny.	
8. E. Spooner, Toronto	Continue studies of quartz vein gold mineralization in the granitoid rocks of Anialik River granite gneiss.	(A. Abraham, PhD)
9. M. Zentilli, Dalhousie	Complete laboratory studies on the turbidite hosted gold quartz veins and stockworks in the Burwash Formation around Gordon Lake.	(T. Stokes, PhD)
10. P. Cerny, Manitoba	Study rare metal pegmatites of the Aylmer Lake pegmatite field.	(Tomachuk, MSc)
11. W.K. Fyson, Ottawa	Mapping of the Beniah Lake straight zone and quartzite-ultramafic sequences in the Beniah Lake area.	(D. Roach, PhD)
12. M. Jebrak, Quebec	Detailed mapping of an area around the Ida Point Montreal silver showings for MSc thesis	(S. Leclair, MSc) (J. Gebert, field advisor)
13. L. Aspler, Carleton	Study Aphebian rock of south western Keewatin to determine their gold (and base metal) potential and relate the rocks to the Nanacho and Hurwitz groups.	(T. Bursey,BSc)

1–7 NWT Geology Division (INAC), 8–13 Canada–NWT MDA

TABLE 3. GEOLOGICAL SURVEY OF CANADA ADMINSTERED MDA PROJECTS

Canada–Northwest Territories Mineral Development Agreement

Regional Geology (LCSD)

PROJECT	DESCRIPTION	GSC OFFICER (STUDENT OR CONTRACTOR)
1. Contwoyto–Nose Lake area	Field work directed at understanding the regional tectonic setting of Lupin-type mineralization.	J. King (C. Relf, PhD, Queen's U.)
2. Tavani greenstone belt	Mapping parts of 55 K/3, 4, 5, and 6 at 1:50 000 scale with emphasis on geochemistry, geochronology, structure and stratigraphy.	S. Tella (S. Rasler, A. Park U. of New Brunswick)
3. Baker Lake mapping and geochronology	Mapping and sampling selected units for zircon U/Pb and Nd/Sm geochronology to establish the age of supracrustals with high potential for base and precious metals.	A. LeCheminant
4. Mystery Lake intrusive suite	Detailed mapping and sampling for a geochemical and isotopic study of the Mystery Island intrusive suite and related alteration haloes in the Echo Bay–Port Radium area, minor work in the Camsell River area to ascertain the relation of Port Radium-type mineral deposits to the intrusive suite.	R.Hildebrand (N. Reardon, PhD, U. of Ottawa)

5. Muskox intrusion	Detailed mapping, geochemical and petrological study of marginal rocks of the Muskox Intrusion and selected areas of the Coppermine lavas and Mackenzie dykes to model magmatic processes and PGE deposition.	W.R.A. Baragar (D. Frances, McGill U.)
6. Cameron River volcanic belt	Mapping the Cameron River volcanic belt north of latitude 63° at 1:50 000 scale, and making a structural and stratigraphic analysis of the volcanic belt and adjacent granitoid and sedimentary terranes.	M. Lambert (D. James)

Mineral Deposits (MRD)

7. Gold Metallogeny –Slave Province	Documenting gold deposits throughout the Slave Province, identifying empirical exploration guidelines, improving genetic models, and assessing the potential of areas where deposits have not been found.	C.I.W. Jefferson et al.
8. Gold metallogeny –Churchill Province	Detailed mapping of gold showings in Henik Group greenstones and equivalents, investigating the impact of Archean sedimentation-tectonism and Proterozoic tectonism on the distribution of gold, and comparing gold metallogeny of Churchill with that of the Slave.	A. Miller
9. South Nahanni tungsten and rare metals	Documenting tungsten, gold, silver, gallium and germanium in the South Nahanni River area by analyzing heavy mineral concentrates from stream sediments, and analyzing Ga and Ge contents of selected samples from Ag-Pb-Zn occurrences in the area.	C.I.N. Jefferson
10. PGE in ultramafic and mafic rocks, NWT	Characterizing mafic-ultramafic bodies and their potential for magmatic sulphide (Ni-Cu-PGE) and oxide (Cr-Ti-V) deposits.	L. Hulbert et al.
11. Rare metals –Slave, Churchill and Bear provinces	Documenting rare metal distribution in deposits and the metal potential of alkalic igneous provinces, comparing the geochemical signatures of these rocks to similar geological environments in Canada.	W. Sinclair
12. Pine Point and Polaris deposits	1)Polaris: detailed underground and surface mapping and drill core logging, recognition and definition of regional and local markers in host rocks, studying "internal sediments" to determine their age and origin. 2)Pine Point: studying oxygen, carbon and hydrogen isotopes of gangue carbonates whose paragenetic relationships to ore have been established through previous studies; studying fluids involved in development of rocks and ore at Pine Point.	D. Sangster 1) (R. Randall, PhD, U. of Toronto) 2) (H. Ching, PhD, McGill U.)
13. Clay Mineralogy and uranium deposits, Churchill and Bear provinces	Documenting and comparing authigenic clay mineralogy in the Thelon Formation (Churchill Province) and Hornby Bay Group (Bear Province), documenting the relation between diagenesis and uranium mineralization.	A. Miller, J. Donaldson, (Q. Gall, PhD, Carleton U.)

14. Metal-stressed vegetation	Using imagery to map vegetation and till around gold- and PGE-bearing gossans, detecting spectral anomalies of gold and related trace elements and PGE in vegetation along mineral belts, integrating the biogeochemical response of stressed vegetation with geology to deline belts of mineral potential.	A.N. Rencz

Quaternary Geology and Geochemistry

15. Gold and PGE in till Churchill and Slave provinces	Determining how gold and PGE mineralization is reflected in associated till and demonstrating till geochemistry as an exploration method, defining patterns of glacial dispersal in areas of gold and PGE mineralization in the central Keewatin and Contwoyto Lake areas.	W. Coker, (MRD)
16. Gold, PGE and rare metals in till –Kaminak Lake	Evaluating areas of gold, PGE and base metal potential by analysis of samples, and resampling areas showing high potential for gold and PGE.	W.Shilts, (TS)
17. Lake Sediment geochemistry	Demonstrating the effectiveness of exploration geochemistry in detecting gold in the Yellowknife Supergroup, in Contwoyto Lake area tundra and in Yellowknife area boreal forest.	E. Hornbrook, (MRD)

Exploration Geophysics

18. Aeromagnetic survey, Whitehills Lake area	Producing aeromagnetic maps and VLF-EM profiles at a scale of 1:50 000.	E.E. Ready, (GEO)
19. Airborne geophysical survey	Providing a geophysical data base for Lupin gold and Blachford Lake (Thor Lake) beryllium and rare metal areas.	B. Charbonneau, (MRD)

Divisions: LCSD – Lithosphere and Canadian Shield, MRD – Mineral Resources, TS – Terrain Sciences, GEO – Geophysics

INDIAN AND NORTHERN AFFAIRS CANADA
EXPLORATION AND GEOLOGICAL SERVICES DIVISION, YUKON

Exploration and Geological Services Division is part of the Mineral Resources Directorate of the Northern Affairs Program, one of five programs of Indian and Northern Affairs Canada. The Division consists of five geologists, an office manager, a map sales manager and a secretary, and is responsible for mineral resources management in the same way as any provincial department of mines.

As part of its mandate, the Geology Division produces an annual review of mineral exploration; the results of assessment work are compiled in another annual publication, the "Yukon Exploration" series. The "Yukon Geology" series is a vehicle for publishing the results of geological research on a variety of topics. Geological maps at a scale of 1:50 000 are available in open file format in certain areas of interest to the mining industry. A complete publications list is available from Canada Map Office, Indian and Northern Affairs Canada, 200 Range Road, Whitehorse, Yukon, Y1A 3V1.

The projects described below were funded either by EGSD, or through the Canada–Yukon Economic Development Agreement (EDA).

GEOLOGY DIVISION PROJECTS—1987

PROJECTS	DESCRIPTION
S.R. Morison Acting Chief Geologist	Mapped and visited placer properties in the Klondike, Fortymile, Sixtymile, Mayo, Atlin and Livingstone Creek areas; studied Quaternary sections in the Stewart River area with Owen Hughes (GSC); helped design and implement geological programs for the mineral resources subagreement of the Canada–Yukon Economic Development Agreement.
J.G. Abbott Minerals Geologist	Visited mining properties throughout Yukon and carried out mineral deposit studies on the MARG, NICK and BLENDE base metal deposits in map sheet 106 D (Nash Creek); edited and published YUKON GEOLOGY Volume 2.
T.J. Bremner Staff Geologist	Visited mining properties in the Dawson Range (115 I) and Kluane Range (115 G) areas and continued 1:50 000 scale mapping near the WELLGREEN copper-nickel-platinum deposit.
D. Emond Staff Geologist	Visited mineral occurrences in the Clear Creek and Scheelite Dome areas (115 P); prepared papers on the geochemistry of tin and tungsten lodes and tin-tungsten-bearing granites in the McQuesten area.
B. LeBarge Acting Staff Geologist	Visited mining properties in the Dawson Range, Kluane, Whitehorse and Mayo–McQuesten areas; assisted Vic Levson with a Quaternary project in the Livingstone and Martin Creek areas (105 E); studied several mineral deposits and carried out geological mapping in the Marsh Lake area (105 D).

UNIVERSITY THESIS PROJECTS	DESCRIPTION
John Dickie Dalhousie University	Sedimentology of the Laberge Group near Whitehorse
Alain Plouffe Carleton University	Feasibility of drift prospecting for gold in the Tintina Trench
Ralph Rushton University of Alberta	Eocene volcanic rocks of the Grew Creek gold deposit
Gary Yeo Acadia University	Geological investigation of lazulite and other phosphate minerals in the Rapid Creek area, north Yukon

CANADA–WEST GERMANY SCIENCE AND TECHNOLOGY EXCHANGE PROGRAM PROJECTS	DESCRIPTION
Addi Germann and Robert Schattner Technical University Aachen, Germany	Mineral deposits of the Rancheria District

CANADA–YUKON ECONOMIC DEVELOPMENT AGREEMENT MINERAL RESOURCE SUBAGREEMENT	**DESCRIPTION**
Program 1: Geological Mapping	
A. Doherty, C. Hart Aurum Geological	Whitehorse mapping project, NTS 105 D/2, 3, 6, 11 Consultants Inc.
Dr L. Hulbert Geological Survey of Canada	Geochemistry and geochronology of layered intrusions in the Kluane area, Yukon
Dr R. Armstrong University of British Columbia	Radiometric age dating in the Wheaton River area (in conjunction with Whitehorse mapping project)
Program 2: Geochemical Surveys	
Geological Survey of Canada	NTS Map Sheets 105 E, 105 K (west half), 105 L, 105 M (south half)

DISCOVERY METHODS FOR CANADIAN METAL MINES THAT OPENED IN 1988

Province	Yukon
Mine	Ketza River
Discovery new or old	Old
Date of Original Discovery (Reassessment)	1955
Technique of Original Discovery (Reassessment)	Prospecting, trenching, diamond drilling
Discovered Reserves	250 000 t (oxide) grading 12.0 g/t Au; 480 000 t (sulphide) grading 10.7 g/t Au
Reassessed Reserves	not applicable
1987 Production	635 349 g from 86 664 t
Mining Type	Underground
Mining Rate	335 t per day
Commodities	Au
Deposit Classification	Manto and chimney replacement of limestone
Key Reference	NMI 105F/9-AU1

GEOLOGICAL PUBLICATIONS

During the March 1989 meeting of the Provincial Geologists it was decided that the listing of provincial and territorial geological publications would no longer be included in this Journal. A list of publications may be obtained from each province or territory through the offices of the geological surveys or relevant information centres or distribution offices of mineral resources departments of provincial and territorial governments.

In addition, publication indexes may be accessed through the National Geoscience Centre in Ottawa. For more information, contact David Reade, Geoscan Centre, Geological Survey of Canada, 601 Booth Street, Ottawa, Canada K1A 0E8 (613–992–9550).

ARTICLES

SURVEY OF FEDERAL - PROVINCIAL MINERAL DEVELOPMENT AGREEMENTS

Province or Territory	Total $ Value of Agreement ($ million)	Cost Sharing Formula	Time Period	Delivery % Canada % Province	Major Components/Projects			Contact Person & Tel. No.
					Project Name	Budget ($,000's)	Delivery (Prov. or Canada)	
British Columbia	$10	50/50	1985-1990	96% B.C. 4% Can.	Geoscientific Surveys	6 650	90% B.C.	G. McKillop (604) 356-2854
					Geoscience Data Systems	450	94% B.C.	
					Market, Technical & Feasibility Studies	1 250	100% B.C.	
					Financial Assist. for Mine Development	1 120	100% B.C.	
					Management, Public Info. Evaluation	530	100% B.C.	
Saskatchewan	$6 380	N/A	1984-1989	50 Can. 50 Sask. Parallel Work Delivery	Geoscience	5 340	41.2 Can. 51.8 Sask.	R. Macdonald (306) 787-2568
					Minerals Technology	400	100 Can.	
					Mineral Development	400	100 Can.	
					Public Information	240	79.2 Can. 20.8 Sask.	
Manitoba	$24.7	60% Fed. 40 % Prov.	1984-1989	60% Can. 40% Man.	Sector A – Geoscientific Activities	13 000	38.5% Man.	W.D. McRitchie (204) 945-6559
					Sector B – Research & Technology	7 430	37.2% Man.	
					Sector C – Development Studies	1 770	50% Man.	
					Sector D – Public Information, Evaluation and Administration	2 500	50% Man.	
Ontario	$30	50/50	1985-1990	63% Ont. 37% Can.	Geoscience Program	18 350	64% Ont.	
					Information Exchange		100% Ont.	(416) 965-1546
					Productivity & Technology	3 550	100% Ont.	
					Economic Development	4 500	96% Ont.	
					Public Information	1 700	59% Ont.	
					Evaluation and Administration			
Québec	$100	50/50	1985-1990	96% Qué. 4% Can.	5 Volets			
					1. Activités géoscientifiques	34 750	Québec	J.L. Caty 643-1803
					2. Recherche et développement sur l'amiante	8 000	Québec-Canada	à déterminer
					3. Infrastructure de développement minéral	42 000	Québec	A. Jean 643-4896
					4. Désenclavement de l'industrie québécoise du mineral de fer	15 000	Québec	G. Richard 643-4410
					5. Information au public	250	Québec	M. Lecours 643-1803

Province or Territory	Total $ Value of Agreement ($ million)	Cost Sharing Formula	Time Period	Delivery % Canada % Province	Major Components/Projects			Contact Person & Tel. No.
					Project Name	Budget ($,000's)	Delivery (Prov. or Canada)	
New Brunswick	$22.3	-	1984-1989	30% N.B. 60% Can.	Geoscience	12 373	31% N.B.	ADM-R.R. Potter North-J.J. Davis Central-L.R. Fyffe South-A.A. Ruitenberg GSC-F.D. Anderson W.H. Poole
					Mining & Minerals Tech.	3 275	8% N.B.	G. Greer or D. Barnett (506) 453-2206
					Economic Development	4 861	57% N.B.	G. Greer or D. Barnett
					Public Information, Evaluation, Admin.	1 798	16.6% N.B.	D. Carroll (506) 453-2206
Nova Scotia	$26.945	60/40	1984-1989	60% Can. 40% N.S.	Geoscience	14 507	62% Can. 38% N.S.	J.D. Keppie MDA Coord. (902) 424-4700
					Mineral Technology	4 982	66% Can. 33% N.S.	
					Development Studies	1 841	48% Can. 52% N.S.	
					Mineral Investment Stimulation Program (MISP)	1 600	80% Can. 20% N.S.	
					Public Information	1 215	37% Can. 63% N.S.	
					Administration	2 800	47% Can. 53% N.S.	
Newfoundland	$22	70/30	1984-1989	45% Nfld. 55% Can.	Geoscientific Surveys	16 400	52% Nfld.	B. Greene (709) 576-2763
					Mining & Mineral Tech.	2 100	29% Nfld.	
					Economic Develop. Studies	1 500	17% Nfld.	
					Public Information, Evaluation and Administration	2 000	30% Nfld.	
Prince Edward Island	$0.3	80/20	1986-1989	100% P.E.I.	Geoscience			
					- Onshore Aggregate Resources	290.6	100% P.E.I.	W. MacQuarrie (902) 368-5011
					- Public Information and Evaluation	9.4	100% P.E.I.	
Yukon Mineral Resources Subagreement	$3.9	90/10 Can./Yukon	1985-1989	100% Can.	1. Geological Mapping	1 100	100% Can. (DIAND)	S.R. Morison (DIAND) (403) 667-3200
					2. Geochemistry	2 200	100% Can. (G.S.C.)	A. Clark (EMR) (613) 995-7789
					3. Placer Mining	600	100% Can. (DIAND)	A. Waroway (DIAND) (403) 667-3153
Northwest Territories	$7.0	70/30 Can./N.W.T.	1987-1991	41% Can. 59% N.W.T.	Geoscience	5.900	52% N.W.T.	M. Irving (403) 920-3125
					Technology	800	94% N.W.T.	
					Information	300	100% N.W.T.	

Survey of Hard Rock Drill Core Programs in Canada, Fiscal Year 1988–89

Province	B.C.**	Alberta	Sask.	Man.	Ont.	Que.	N.B.	N.S.	Nfld./Lab.	P.E.I.	Yukon	N.W.T.
Number of facilities	1	1	1	4	7	3	3	4	5	1	1	1
Staff-person days work 1988–89	66	30	91	270	3,344		740	914	810	-	135	100
Capital cost 1988–89 ($ x 000)	nil	nil	nil	4.0	49.2		600.0	2.0	-	-	63.75	0.3
Operating cost 1988–89 ($ x 000)	3.0	12.5	5.6	15.5	144.6		80.0	130.0	139.6	-	18.32	19.2
Core collected and/or delivered 1988–89	- m	4,000 m	2,654 m	7,440 m	56,630		24,500	14,503	420,983	-	11,143	7.5
Core reduction*	nil	nil	nil	5,310 m	21,461		nil	nil	nil	-	nil	nil
Use of facilities person days (pd) 1988–89 visits (v)	110 pd	20 pd	44 pd	29 pd 15 v	1,835 pd		200 pd	649 pd	88 v	2	35 pd	33 v
Total core in storage (from all years)	150,000 m	30,000	95,757	174,800	689,568		281,433	450,000	667,783	1,298	118,539	30,056
Total exploration drilling 1988–89	12,094 m	4,000	195,904	271,000	1,020,000		150,000	105,000	235,000	-	86,103	185,430

* Over last year

** Coal core is not hard rock. There are no facilities for hard rock in B.C. Figures are for coal.

1989/90 Annual Reviews of Activities
Provincial and Federal Geoscientific Organizations

Provinces or Territory Location	Date(s) (No. of days)	Time for talks	Universities involved?	Industry involved?	Poster session	Universities involved?	Industry involved?	Publication	Energy[1] matters	Other[2] topics	Comments
British Columbia Vancouver	7 Feb.90 (1 of 4)	1 day	Yes	Yes B.C. & Yukon Chamber Annual Meeting	Yes	Yes	Yes	- Geological Fieldwork - B.C. Mineral Exploration Review, 1989	Yes	Yes	Part of "Cordilleran Geology and Exploration Roundup" 6 Feb. - GSC; DIAND-Yukon 7 Feb. - BCENPR 8,9 Feb. - BC-YCM
Yukon Territory Whitehorse (DIAND)	26-28 Nov.89 Whitehorse (2)	2 days	Yes	Yes	Yes 2 days	Yes	Yes	No	No	No	Contributions from DIAND, GSC and industry. Review of current projects
	6 Feb.90 Vancouver (1 of 4)	one 1-hour session	No	No	Yes	Yes	No	No	No	No	Part of "Cordilleran Geology and Exploration Roundup" with BCENPR, BC-YCM, GSC
Northwest Territories (DIAMD)	5-7 Dec.89 (3)	3 days	Yes	Yes	Concurrent Dec. 5-7	Yes	Yes	Exploration, Mining and Geology Overview	Coal only	as required	Organized with NWT Chamber of Mines, GSC involve. Also take part in "Cordilleran Geology and Exploration Roundup", Vancouver.
Alberta (to be determined)				Bi-Annual: Scheduled Fall 1990							
Saskatchewan Regina	21,22 Nov.89 (1.5)	0.5 day	Yes	No	1 day	Yes	Yes	Summary of Investigations	No	No	Sask. Research Council and GSC involved.
Manitoba Winnipeg	27-29 Nov.89 (2.5)	2 days	Yes	No	2 days	Yes	Yes	Rept. of Field Activities	No	No	GSC companion Rept. Field Activities released as GSC Open File
Ontario Toronto	11-13 Dec.89 (2.5)	2.5 days	Yes	Yes	2 days	Yes	No	2 Repts. of Activities	Yes	Yes	Research oriented, Mineral Dev. Forum
Quebec Quebec City	29,30 Nov.89 (2)	2 days	Yes	Yes	2 days	Yes	No	Rept. of Activities	No	Yes	Special publication of talks presented.
New Brunswick Fredericton	20,21 Nov.89 (1.5)	1.5 days	Yes	No	1.5 days	Yes	Yes	1989 Project Resumes	Yes	Yes	GSC involved
Nova Scotia Halifax	22,23 Nov.89 (1.5)	1 day	No	No	1 day	Yes	No	Program and Summaries	Yes	Yes	GSC involved; also symposium, N.S. Chamber of Mineral Resources
Newfoundland St. John's	2 Nov.89 (1)	1 day	Yes	Yes	0.5 day	Yes	No	Yes	Yes	Yes	GSC involved
Prince Edward Island Charlottetown	2 May 90 (1)	No	No	No	1 day Energy matters	No	No	No	Yes	Yes	Mineral, Forestry and
Geological Surv. Can. – Ottawa	16,17 Jan.90 (2)	2 days	Yes	No	2 days	Yes	No	Abstract vol. current Research	Yes	Yes	Provincial agencies involved; GSC Minerals Colloquim follows Jan. 17, 18, 1990

[1] Energy Matters: (e.g. oil, gas, coal, oil shales, peat) [2] Other Topics: (e.g. administration, engineering, regulations, legislation, etc.)

Discovery Methods for Canadian Metal Mines that Opened in 1988

Province			**Ontario**			
Mine	**Golden Particia Mine**	**Holt-McDermott Mine**	**Kremzar Mine**	**Magio Mine**	**Winston Lake**	**Pan-Empire Tailings Operation**
Discovery	New	Old	Old	Old	New	Old
Date of discovery (Reassessment)	1985	(1981)	(1983)	(1981)	1979	(1986)
Discovery technique	Geophysics, Diamond drilling	Diamond drilling	Diamond drilling	Mine workings examined, Diamond drilling	Diamond drilling	N/A
Reserves	868 000 tons grading 0.58 oz Au/ton	4.7 million tons grading 0.14 oz Au/ton	Proven and probable: 615 724 tonnes grading 5.91 g/t Probable: 203 248 tonnes	1.9 million tons grading 0.25 oz Au/ton	2 684 379 tonnes @ 15.26% Zn, 1.05% Cu, 31.37 g/t Ag 1.07 g/t Au	150 000 tons grading 0.2 oz Au/ton
1988 Production	—	23 848 oz Au	2132 oz Au	—	73 755 lbs Zn 3051 lbs Cu 68 275 oz Ag 2428 oz Au	—
Miningtype	Underground	Underground	Underground	Underground	Underground	Surface
Milling rate	275 tons/day	1500 tons/day	550 tonnes/day	400 tons/day	1000 tonnes/day	200 tons/day
Commodities	Au	Au	Au	Au	Au	Au
Deposit classification	Vein	Fault-related? Altered zone	Vein hosted load Au	Vein	Volcanogenic massive sulphide	Tailings processing
Key reference	Metals Economics Group 1988	Metals Economics Group 1988	Metals Economics Group	Metals Economics Group	—	Metals Economics Group

Reference: Metals Economics Group *Active Canadian Gold Mines November 1988*

Discovery Methods for Canadian Metal Mines *(continued)*

Province	Ontario		Saskatchewan	British Columbia	Nova Scotia
Mine	Timmins Tailings Treatment Operation	Kirkland Lake Tailings Treatment Operation	Jolu Rod Zone	Reg Deposit (Johnny Mountain)	Tangier
Discovery	Old	Old	New	Old Prospect	Old
Date of discovery (Reassessment)	(1986)	(1986)	1984	Early 1900s (1981)	1861 (1986)
Discovery technique	N/A	N/A	Prospecting, drilling	Prospecting (drilling, underground development)	Prospecting (geological, drilling, underground development)
Discovered reserves	189 600 000 tons grading 0.013 oz Au/ton	6.7 million tons grading 0.041 oz Au/ton	376 500 t @ 13.7 g/t (0.4 oz/ton)	1 058 000 tons 0.644 oz Au/T	N/A
Reassessed reserves			N/A	876 000 tons @ 0.55 oz Au/t (all categories)	115 000 t @ 0.23 oz/t (Assays in excess of 1 oz cut to 1 oz)
1988 Production	400 000 tailings treated	7083 oz Au	10 202 oz	26 670 tons milled Nov.1–Dec.31 yielding: 10 906 oz Au; 21 306 oz Ag;	436 oz from 16 624 t milled (development muck and ore)
Miningtype	Surface	Surface	Underground	Underground	Underground
Milling rate	36 650 tons/day	2250 tons/day	400 TPD	200–245 TPD	200 t/day
Commodities	Au	Au	Au	Au, Ag, Cu	Au
Deposit classification	Tailings treatment	Tailings treatment	Vein	Vein – Mesothermal	Vein
Key reference	Metals Economics Group	Metals Economics Group	SMDI 0901	MI 104B, 077, 107, 260, 261, 262, 263, 268	NSDME

Reference: Metals Economics Group *Active Canadian Gold Mines November 1988*

OPEN LETTER
to the
COMMITTEE OF PROVINCIAL GEOLOGISTS

Anthony J. Andrews

JUNIOR MINING COMPANIES AND PROSPECTORS: MINERAL INDUSTRY RESEARCHERS

Prospectors and junior mining companies concentrate their efforts and activities on the finding and development of new prospects and, in doing so, serve to replenish the inventory of Canadian mineral resources. The junior companies and prospectors can be counted among the key players of the exploration process and, as such, are the main *researchers* of our industry.

Strong Performance Yields Results

In recent years, the performance of our researchers has been exemplary, thanks largely to flow-through shares. The benefits to the Canadian economy—especially the economies of the smaller communities—have been tremendous.

The total exploration expenditures over the six-year period between 1983 and 1988 amount to about $4.8 billion, approximately $3 billion of which can be attributed to flow-through share financing and the resulting activity of junior mining companies. This wave of investment in the search for Canadian mineral deposits has led to the discovery of many new prospects and to the creation of a significant number of new mines. Based on information supplied by the provincial and territorial governments, Statistics Canadian, and Energy, Mines and Resources Canada, our tally as of December, 1988, is:

- over 200 new discoveries (a figure which should increase substantially with time);
- 115 projects in the advanced stage of exploration, i.e., proceeded to underground or open pit exploration;
- 58 projects in the developmental stage, i.e., projects which have announced production, and
- over 60 new producing mines (counting from 1986).

1989 – A Time of Transition

Unfortunately, the flow-through success story has not continued into 1989. Today, the flow-through share market is weak, with the result that many junior exploration and mining companies are experiencing a significant degree of difficulty in raising the funds which are desperately needed to maintain a minimum level of exploration. The sad state of flow-through can be attributed to a number of factors, including:

a. a low gold price

b. a lack of investor confidence in the stock market

c. confusion over new flow-through rules, and

d. the detrimental effect of certain tax rules pertaining to flow-through shares.

We cannot do anything to affect the price of gold, but we can address the investors' confusion and uncertainty, and we certainly intend to persist in our efforts to obtain fair and equitable tax rules. Towards fulfilling these two goals, the PDAC has resolved to implement an education and publicity campaign for the purpose of educating the investing public about the merits of mining and flow-through shares, clearing away any confusion surrounding new flow-through rules, and boosting investor confidence in mineral exploration.

The PDAC will persist in its representations to the Federal Department of Finance to obtain more favourable income tax rules for flow-through shares, with emphasis placed on the problems associated with adjusted cost base and cumulative net investment loss.

We cannot emphasize strongly enough the need to maintain adequate levels of exploration, particularly in light of Canada's seriously depleting base metal reserves. As concluded by A. Lemieux of the Federal Department of Energy, Mines and Resources, "To meet the challenge and find enough deposits to take over from those nearing exhaustion, it will be necessary to keep annual exploration spending in Canada at *least* at the 1987 level, i.e. $1.3 billion, for the foreseeable future ...".

LAND: THE MINERAL INDUSTRY RESEARCH FACILITIES

The land that is available for exploration is our research laboratory. Limiting or restricting access to the laboratory significantly diminishes the probability of succeeding in the exploration effort. We are currently restricted in our access to large tracts of prospective lands because of unresolved Native land claims and a considerable variety of single use designations, primarily in the form of parks.

Native Land Claims

Progress is Appreciated

We appreciate the complexities involved in the resolution of Native land claims. In this regard, we would like to congratulate the representatives of the federal government and Native groups who were involved in the successful negotiation of Agreements-in-Principle for both the Yukon and the Northwest Territories.

We realize that this dialogue must continue because there is much work yet to be done and complex negotiations still to take place before a final agreement is reached. We must all ensure that the negotiators on both sides give consideration to the basic requirements of a healthy and viable exploration and mining industry, an industry that has the potential to play a vital role in moving the territories towards greater economic independence in the future.

With this goal in mind, the PDAC, cooperating with the Mining Association of Canada, the NWT Chamber of Mines and the Federal Department of Indian and Northern Affairs, was involved in the joint organization of a workshop on June 12, 1989, to initiate direct contact between the Federal negotiating team, the Denis and Metis representatives of the mining industry. The workshop resulted in a communication to the Hon. Pierre Cadieux, in the form of a brief outlining industry recommendations and concerns. A similar workshop will be organized to discuss the Yukon Agreement in Principle.

We urge the federal and provincial governments to move expeditiously to resolve all Native land claims to the satisfaction of all involved. Native grievances should be taken seriously and dealt with objectively for the benefit of all Canadians. Whether, in the final analysis, we do business with governments or with Native Indian groups is not a concern in itself to the members of our industry, as long as the right to access and security of title are guaranteed for all Canadians and the industry is not burdened by having to pay double duty to both the Indians and to the Crown.

Parks

The PDAC supports the existence of parks. Indeed, we would suggest that the people of the exploration and mining industry constitute a major proportion of those Canadians who make use of the recreational resources and facilities of our northern wilderness parks. The land is characterized by numerous and varied types of potential resource values and has, as a consequence, numerous potential users. Only policies of multiple land-use management can serve to bring it to its full potential for the benefit of all Canadians.

We at the PDAC are deeply concerned with the growing competition for crown land, particularly with respect to the increasing trend towards single land-use designations.

We identify three main problem areas which deal with:

a. the restrictive policies regulating use of and access to parks;

b. the steadily accumulating inventory of parks; and

c. the process involved in their planning and designation.

Policies on Use and Access

There are currently no federal parks and very few provincial parks in Canada which operate on the basis of multiple land-use management policies, a situation which causes our members serious and continuous frustration. To illustrate the point, we draw attention to what appears to be a new manifestation of park creation, in the form of river parks (also referred to as waterway parks and recreational corridors). Typically, a river park consists of a long, narrow corridor which contains a stretch of river and a buffer zone, the latter normally a few hundred meters wide on wither side, but, in some cases, expanded to include the whole watershed in the immediately surrounding area.

Recent examples of provincial initiatives in this regard include the Lower Stikine River in British Columbia, the Clearwater River in Saskatchewan, and the French, Albany and Spanish Rivers in northern Ontario. The Canadian Heritage Rivers Board, comprising federal and provincial government representatives, has been set up to consider the creation of river parks in every province and territory of Canada.

We do not oppose the formation of river parks. However, many of them have been designated specifically for recreational purposes, to the exclusion of all other activities. In addition, access is restricted to recreational users and, in many cases, the construction of bridges is prohibited. As such, river parks are of particular concern to the exploration industry as they effectively truncate or isolate significant areas on either side of their banks. This is especially significant in the case of the Canadian Shield which covers most of central Canada. Here, north-south flowing rivers crosscut east-west trending, highly-prospective greenstone belts.

The Increasing Inventory

The problems generated by the implementation of single or exclusive land-use policies are compounded by the fact that additions to the inventory of alienated and restricted lands occur on an almost continuous basis and under a wide variety of designations, such as (in addition to parks) recreation areas, wilderness reserves, habitat reserves and sanctuaries, to name but a few.

The PDAC estimates that exploration is currently prohibited or unreasonably restricted on over ten percent of Canada's total land mass, equivalent to approximately the area of Manitoba and Saskatchewan combined. This situation is even more advanced in the U.S.A., and the precedent we observe there is cause for the most serious concern.

The Process of Park Creation

The industry needs to be involved in the decision-making process of park planning, creation and management. Rather than being excluded, as we have been in the past, we ask that our voice be heard *alongside* other interests. In this respect, we rely on the federal and provincial Ministries of Mines to monitor proposals for the creation of new parks and other designations, to advocate strongly on our behalf, and to relay appropriate information to us in order that we may contribute constructively to the decision-making process. Of fundamental importance is the support of Ministries of Mines in helping to establish multiple land-use as the management policy applied to all public lands, including federal and provincial parks.

Canadians Support Multiple Land-Use

The PDAC is most encouraged to have recently obtained statistical information indicating that the majority of our citizens would support exploration and mining in the wilderness parks and recreation areas of Canada. This information was obtained as part of an Angus Reid national poll, commissioned by The Mining Association of Canada, the PDAC, and provincial associations, and conducted in April and May of this year. The report describing the results of the poll is entitled, "Canadians' Perceptions and Attitudes Towards the Mining Industry and Related Policy Issues", and we quote from it as follows:

> *"Fully 70 percent of Canadians stated that they would allow prospectors to search for mineral deposits in parks and wilderness areas so long as they do not disrupt the environment, and 59 percent would allow such activity in recreation areas under the same conditions. A majority of the members of all three attitudinal groups would be prepared to support exploration in both wilderness and recreation areas. While support for this type of activity was highest within the Pro-Industry segment, it is important to note that even a majority of the Antagonists are prepared to support exploration.*
>
> *Should a sizeable deposit of minerals be located, then 64 percent of Canadians would support widespread (10%) or limited (54%) mining in a wilderness area. Given a similar scenario in a recreation area, 55 percent of Canadians would support mining on a widespread (7%) or limited (48%) basis. As is the case for exploration, a majority of the members of each of the three attitudinal groups would support some mining activity in each of these areas. Again, support for mining activities in wilderness and recreation areas was highest within the Pro-Industry segment; however, a majority of the antagonists would also support mining in these areas".*

The PDAC is particularly encouraged by the fact that the majority of Canadians would support "limited mining" in wilderness parks and recreation areas. In the vast majority of cases, mining operations affect only an insignificant portion of the land surface and, therefore, only "limited" mining activity is required in any given area. Indeed, the total area occupied by *all* mining operations represents a very limited and insignificant portion of the total Canadian land mass, not much larger in area than the occupied metropolitan Toronto.

Mining Industry Land Use Strategy

Aware that facts are needed to support our claim of land alienation and that action must be taken to counter the threat that it represents to our industry, the PDAC, in conjunction with The Mining Association of Canada and provincial and territorial mining associations, adopted a Mining Industry Land Use Strategy (MILUS) in the spring of 1989. A statement of principles was subsequently endorsed by the associations and a five-point program of action adopted. The following are the principles that will be used under MILUS:

- acceptance and support of the concept of sustainable development;
- acceptance of the legitimate public interest in the conservation or preservation of certain areas;
- support for the principle of integrated resource management;
- cooperation with other resource users;
- advancement of public knowledge;
- support for fair and open processes of land use regulation and planning;
- challenging unreasonable land use or access restrictions on the basis of fact and science.

The five-point action plan consists of the following:

1. Establish a data base of lands currently withdrawn from or restricted to exploration and mining;

2. Work in cooperation with other resource users;

3. Advance public knowledge;

4. Advocate fair and open processes;

5. Challenge unreasonable land use or access restrictions.

MILUS is an important strategy that will need the assistance and cooperation of everybody in and connected with exploration and mining. We are asking you, as supporters and advocates of our industry, to support this initiative and to help us in what will be undoubtedly a challenging task.

THE RESEARCH TOOLS: GEOSCIENCE INFORMATION

The services and products of the federal and provincial geological surveys are the primary research tools for mineral exploration. The geological maps and reports, the geophysical and geochemical data, assessment files, mineral statistics and inventories that comprise the geoscientific data base of our country, constitute our research library.

We face the major challenge of replacing Canada's seriously depleting base metal reserves. This, considered together with the fact that most of the ore bodies of tomorrow are situated at depths below the surface of the land, means that our dependence on geoscientific technology and information is ever increasing in importance. A commitment to maintain adequate support to geological surveys, enabling them to provide the required quality of product and services, is, therefore, vital in our efforts to meet the challenge successfully.

Mineral Development Agreements

The industry is most concerned about the immediate future of the Mineral Development Agreements (MDA's), particularly in the context of the recent federal budget which contained a strong emphasis on fiscal restraint.

We reiterate our position that the MDA's represent one of the most effective geoscientific information programs to have been implemented. With few exceptions, they have provided the resources for provincial and territorial geological surveys to carry out basic, essential work programs.

On the one hand, a firm commitment is needed from some of the provincial governments to establish more satisfactory levels of support in their own constituencies. On the other hand, the abrupt withdrawal of MDA support at this time will result in a serious disruption in the continuity and progress of geological survey programs in many of the provinces and territories. We strongly recommend the renewal of MDA's for at least one more term, in order to give the provincial governments time to re-establish their own commitments.

While the MDA programs appear to have survived the trimming of the Federal budget, at the time of writing (November, 1989), there has been no specific reference as to how new programs will be allocated. The industry continues to wait for an announcement on this most important matter and we urge the Federal Government to make decisions as quickly as possible.

The Geological Survey of Canada

The Geological Survey of Canada (GSC) has contributed very significantly to establishing and maintaining the Canadian geoscientific data base through geological, geophysical and geochemical research and surveys and the production of maps—a contribution which has earned the GSC a well-deserved, international reputation for quality and relevance.

The exploration and mining fraternity is concerned that this legacy is already beginning to suffer under the combined pressure of long-term staff reductions, increasing intensity of fiscal restraint, and a broadening mandate. In addition to the recent loss of approximately 80 individuals employed under the MDA program, the human resource pool of the GSC is being gradually eroded through the long-term civil service reduction policy of the federal government. The high average age of the permanent staff (about 47) raises concerns with respect to whether or not the organization can maintain effective field mapping programs as a top priority and reflects a dangerous lack of attention to young, new talent. We recommend that appropriate numbers of term staff positions be maintained not only for the purpose of providing much needed support, but also for identifying and streaming in new talent to permanent positions.

The deteriorating condition of the environment and an increasing frequency of natural hazards have grown to be major national concerns, and the GSC's mandate to address both of these concerns has grown proportionally. While, in principle, we must commend this development, in practical terms there is a concern that, under the combined pressures of staff reduction and fiscal restraint, such increases in responsibility will only be accomplished at the expense of the GSC's traditional role of supporting and contributing to the Canadian geoscientific data base.

Obtaining data relevant to environmental concerns and to natural hazards will involve geochemical, geophysical and geological measurements of a specialized nature and probably from a specific approach. However, much of the same data can be applied to mineral deposits studies and research on exploration.

In this context, we strongly recommend an integrated, complementary approach to the expanding mandate of the GSC, as opposed to one which would result in competition for a limited and finite source of funds.

The Geoscientific Database of the Territories

Developing the great mineral potential north of the 60th parallel must be an integral part of any long-term economic strategy for the Yukon and the Northwest Territories.

However, mapping programs in the Yukon and the Northwest Territories have fallen far behind those of most other areas in Canada and, indeed, the development of the geoscientific data base in recent years has all but stagnated. This will do little to support the needed development.

We stress the need for retaining the traditional support and contribution of the GSC in the development of the geoscientific data base in the Territories and, in particular, the 1:250 000 scale mapping programs. There is a concern that support for current and future work of the GSC in the territories is shifting from A-base budgets to MDA's. We agree with the position of the Yukon and Northwest Territories Chambers of Mines that a firm commitment of support should be made on the level of A-base budgets, with MDA's being used in a supporting role.

We commend the Government of the Northwest Territories for its recent initiatives to consolidate and strengthen its geological survey programs and strongly urge the Yukon government to follow suit. We encourage both governments to develop the local expertise, services and facilities which are badly needed to foster exploration and development north of the 60th parallel.

Computerization of the Geoscientific Data Base

In our presentation to you last year, we expressed concern about the fact that, while provinces were moving towards various levels of computerization of the geoscientific data base, there was apparently little attention being paid to standardization and compatibility among these developing systems.

In this regard, we welcome the recent formation of the National Geological Surveys Committee (NGSC), a group representing the provinces, territories and the Geological Survey of Canada, and charged with the task of identifying compatibility standards which might be adopted by the various jurisdictions.

For practical reasons, however, it now appears inevitable that the Provincial Surveys will need to develop systems that are, to varying degrees, tailored and specific to their own special needs and those of their constituencies. In the light of this reality, devising an efficient mechanism for accessing all of the wide-ranging data contained in provincial data bases becomes a matter of critical importance.

We see a solution to this situation in the development of a standard Canadian language that all the Provincial Survey systems are able to communicate in. This would provide the means by which any industry user, at any given location and with a computer at his disposal, could access data from any province using either modem or diskettes.

Developing a system of this type will require significant levels of funding and strong direction. We recommend that the Geological Survey of Canada be provided with the resources and directives necessary to assume a leading role in this long-term and most important endeavour.

Long-Term Planning and Project Selection Criteria of the Provincial Surveys

In general terms, we believe that the Provincial Geological Surveys should take a pro-active rather than a reactive approach to the generation of basic geoscientific data and research into the mineral potential of the provinces. In other words, the Surveys should lead rather than follow. By this, we do not mean that the Surveys should be unresponsive to industry. Rather, we would suggest that a certain proportion of resources be readily available to address immediate problems in specific areas as they arise.

Given this approach, programme selection should be addressed in terms of long range planning, say 5 to 10 years, with annual stewardship and budget allocation reviews rather than annual project selection reviews. We recognize that this approach is probably being followed to some degree at the present time and that many of the projects selected on an annual basis are in fact subsets of longer range programmes.

In terms of priorities, we believe there are four:

a) Basic geological mapping;

b) Acquisition of raw geochemical and geophysical data;

c) Basic research into ore deposit models; and

d) Timely dissemination of the results of this research to the public in a readily usable form.

Basic research into ore deposit models is important if the Surveys are to take a pro-active rather than a reactive role. The results of this type of research will be of great benefit in the selection of high priority areas for other survey work. The objective of this research would be to find geological environments in Ontario which have the potential to host world class deposits. While we believe that the Provincial Surveys should take a lead in this type of research, we also believe that this is an area where close contact should be maintained with industry and universities to ensure coordination and to avoid duplication of effort.

With regard to geological mapping, we would suggest that areas be selected on the basis of the following criteria, in descending order of priority:

i) High mineral deposit potential;

ii) Good infrastructure leading to a high potential for development; and

iii) The absence of recent mapping at a suitable scale.

A well-designed programme would include projects in all three categories.

The same criteria should be applied to the acquisition of raw geochemical and geophysical data, and areas which have already been covered should be reviewed in light of recent technology development to see if benefits could be derived from additional survey methods. In the case of airborne geophysical surveys, great care should be taken not to duplicate available, effective, prior coverage by industry.

We believe that projects should be so designed that the basic information and raw data can be made public as quickly as possible. A growing number of companies and individuals in the industry now have access to various types of computer software and hardware and could handle the basic data in digital form.

Canadian Exploration Statistics

The PDAC Exploration Statistics Committee has taken on the task of developing a set of *'leading indicators'* which will serve to monitor, on a continuous basis, the activity and health of the exploration industry across Canada.

Our goal is to gather, on a quarterly basis, a select group of statistics which, taken together, will reflect all stages of exploration activity, from grassroots to the advanced stages. The emphasis will be on *relative* rather than *absolute* values and the examination of trends.

Initially, the statistics will include Provincial and Territorial totals of:

a) Frequency of visits to local resident geologist offices;

b) Information on claims;

c) Number of work permits approved for exploration;

d) Number of assessment reports submitted;

e) Footage of diamond drilling; and

f) Line/kms of airborne geophysical surveys flown.

All the data will be tabulated and plotted at the PDAC Toronto office and made available as a quarterly report to all participating organizations and Association members. For the PDAC, the information will provide us with a continuously updated set of indicators reflecting the trends and activities of exploration across Canada. This will be a vast improvement to the current situation, whereby we have to depend on government statistics, which in most cases are not readily available and are only published once a year.

GEOSCIENCE INFORMATION SYSTEMS IN CANADIAN GEOLOGICAL SURVEYS

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INTRODUCTION

The term Geoscience Information System is an umbrella expression which refers to the concept of multiple computerized datasets, databases and software which can be accessed to satisfy data/information requirements. A fully developed Geoscience Information System (GSIS, a new acronym), would have a common interface which would allow data to be easily extracted from a myriad of different sources and output in a set of common formats. A GSIS will use one or more types of spatial data management, manipulation and analysis software generally referred to as GIS (Geographic Information Systems) software as a large component of the system, but the term will usually denote more than the use of just one GIS package which normally could not be expected to perform adequately with all the different types of geoscience data. A GSIS can handle data sets that are distributed in 3D space, whereas today's GIS products are best at manipulating data that are distributed in 2D space. Realistically, the creation of a GSIS requires accepting and using a variety of suitable software tools developed both commercially and in-house, and building an infrastructure of standards and linkages to support the concept.

Why create a GSIS? One of the primary roles of geological surveys is to collect, analyze, store and distribute geoscience information (Prov. Geol. Journal, v. 5, p. 129-142, 1987). Geoscience information comes in large volumes in a great number of different formats. Historically, a significant proportion of data collected was neither properly described and archived, nor published, and has been lost. Much of what could be called the "Canadian geoscience database" is presently available only in hard copy form. With the recent advancements in sophisticated spatial analysis and manipulation software, demand has grown for digital data which can be used in these packages for such things as policy analyses, global change studies, exploration and development initiatives, geoscience research, and the development of better information products. Although providing these data is costly, the cost of not doing it may well be even larger if surveys become unable to respond to the reasonable requirements of their clientele whose expectations will be elevated by observing developments in other countries and by the capabilities of technology. Since providing data in multiple incompatible formats does not constitute good service to anybody, either within or external to the organization, it follows that there is a requirement both for the digital data, and for the set of software tools, linkages, standards and interfaces that we are calling a GSIS.

BACKGROUND

During the past 25 years, data essential to GSIS such as mineral deposit inventories, gravity and aeromagnetic surveys, geochemical surveys, etc., have been computerized to varying degrees in both provincial and national surveys, often with little coordination between programs, much less surveys. This was largely due to the existing data processing environment based on mainframes, minicomputers and homegrown software. General purpose GIS software did not (and could not yet) exist given the relatively low processing power of even mainframes. Some surveys in Europe have built their own GSIS, or cooperated with other agencies in their countries to build such systems during the last ten years. For example, in Finland they have a system called FINGIS which works well because of a complete set of data interchange standards and programs which transform datasets into a standard format. However, as our European colleagues have found, software development and maintenance is a person intensive activity which should not be undertaken without a sufficiently large pool of staff or money.

During the last five years, literally hundreds of spatially oriented software packages have been developed commercially, some for microcomputers that are as powerful as yesterday's mainframes. In this environment, it makes sense to talk about GSIS because the potential overall benefits, including the production of automated or partially automated map products, ease of update, the ability to do analysis and produce derived products, plus the increased ability to respond to client requirements, outweigh the still significant acquisition and development costs. Most of the national surveys in other countries are acquiring commercial GIS packages as an addition to or as a replacement for homebuilt software, and are using one or more of these packages in conjunction with a relational database management system. In some cases, for example the Federal Republic of Germany, a determined attempt to develop an integrated system is being made, while in others the emphasis is on data exchange standards.

With the development of microcomputer GIS software, came the ability of even poorly funded surveys to get into GSIS. The major impediments have become the lack of digital data in suitable formats and the lack of both money and personnel to deal with the data management problems (digitization, acquisition, conversion, reconciliation, interpretation).

PRESENT STATUS

While a number of the European surveys have already established integrated or partially integrated systems, Canadian surveys are only in the planning and initial development stage. Most provincial surveys as well as the Geological Survey of Canada have begun the planning and development necessary to create a GSIS, with varying levels of commitment to the process. The Quebec survey completed a pilot project for which all data sources in one area were digitized and the possibilities of the technology were explored. They are currently evaluating the pilot and planning the extent of future commitment to the technology. Several surveys are experimenting with and using GIS software such as Arc/Info, SPANS, CARIS and System 9 for specific applications. Two surveys are also involved in the automation of the cartographic process and the creation of related geological databases. The main problem that faces all surveys in Canada is the size of the proposed task and the lack of sufficient resources to fund the significant development effort that is needed to design the systems, purchase the hardware and software, enter the data, maintain the systems, attract and keep expert staff and educate users about the benefits of using GSIS.

The Committee of Provincial Geologists, in its brief to the Mines Ministers' Conference that was held in Quebec City in 1988, recommended that the Ministers "support as a high priority the computerization of geoscience databases and the adoption of GSIS's, while maintaining the ongoing information gathering activities". The National Geological Surveys Committee (NGSC), which consists of the territorial and provincial geologists and the Assistant Deputy Minister of the Geological Survey of Canada, recognized that for such a recommendation to be successfully implemented, cooperation among geological surveys is crucial. This will optimize both the effective use of scarce resources and compatibility between the GSIS's specific to each jurisdiction.

To start the cooperative process, the NGSC held a GSIS workshop in Ottawa, in November of 1988, which was attended by staff from most geological surveys. This workshop became the founding meeting of the GSIS Coordinating Subcommittee of the NGSC. Some of the more important terms of reference of the Subcommittee are summarized below:

- national focus
- sharing of information on:
  - computer systems and database management techniques
  - results of data base projects (costs, technology, system introduction)
  - current and future GSIS activities and plans
- users' needs
- cooperative projects
- national inventories

Participants agreed that the first steps in a cooperative effort was to create inventories of existing digital (or potentially digital) datasets and GIS projects in each survey. The Geological Survey of Canada (GSC), which had just begun the process of creating a directory of GSC data, volunteered to add provincial data to this directory and manage the project of creating what could truly then be called the Canadian Geoscience Data Directory. The needs for standard data exchange formats will be prioritized and specific recommendations for exchange formats will be made. A standard data dictionary may be developed. These decisions are completely in line with what is happening internationally where data directories exist (e.g. Great Britain, USA), or are in the process of being created (e.g. Australia). Questionnaires were developed, revised and sent out during 1989, and the results are now coming in.

The Ontario Geological Survey offered to coordinate and manage a GSIS project inventory which would enable staff in each survey to keep abreast of relevant ongoing developments. Some effort has been made to design this inventory which will be created during the next few months. These inventories are considered to be the building blocks of good inter-agency communication and cooperation.

The process of sharing experience and knowledge between geological surveys has begun: a network of people is in place. Now the dedication of a committed core group is needed to maintain the momentum. Each geological survey has to put time and effort into this venture now, to take good advantage of the cooperative process.

THE FUTURE

Challenges and Opportunities

The establishment of Geoscience Information Systems in Provincial and Federal Surveys should not be viewed as the introduction of a few computers that create a minor diversion from the other, more important, activities of the Surveys. We are at the start of a period of fundamental change; a period in which digital data in particular and information in general will be viewed as a resource with a high value. To give data value requires that they be easily available to and in the appropriate form required by those who need to use them. This currently is not the case.

To make data readily available requires the building of an information infrastructure. Until recently, infrastructure building was limited to physical support systems, for example, the creation of road and telephone networks. The new challenge of this decade and beyond is the building of an information infrastructure. In order to make this happen data must be regarded by organizations as a resource. The comparison of information systems with road and telephone networks is deliberate as these now mature networks were established only after very large capital investments had been made and there was acceptance of the need to maintain them. Geoscience data are a small part of the over-all information environment, but obviously a significant part. As minor players in the information business, geological surveys must look to established and emerging data standards and methods currently being used or developed. Thus, this work must not be done in isolation from other disciplines and organizations as they are also working on building the means to provide effective information services for the benefit of their own clients.

The competitiveness of any economy or sector of an economy will primarily be based on how effectively information can be organized, accessed and utilized. This provides the underlying impetus for change for all organizations that handle information.

Developing an information infrastructure for geoscience will require a major commitment from each survey both in capital investment and also in the development of new skills to manage these projects successfully. The geoscience organizations are not alone in these activities. Standards will have to be coordinated nationally. This includes adoption of existing standards and development of extensions to existing standards for geoscience information.

The development of an infrastructure for geoscience information means that all activities related to the collection and handling of information generated by geological surveys will have to be re-examined. Major investments in training will be needed by surveys to enable staff to collect, analyse, manage and distribute the data. End users also require education to make use of the data. Considerable coordination will be required between external users and the designers of Geoscience Information Systems so that useful and practical services are provided.

With the increased use of computers in the handling and delivery of geoscience information, many changes will continue to be made to current methods used by surveys. Since the investment required to build a geoscience information infrastructure is considerable, it is imperative that there be an open exchange of experience gained on projects between surveys, and that management at the assistant deputy level and higher be both aware and supportive.

GEOSCIENCE MAP SYMBOLS USED BY FEDERAL, PROVINCIAL AND TERRITORIAL GEOSCIENCE ORGANIZATIONS

G.W. Cameron, R.P. Ridbihough, and members of the
National Geological Survey Committee

Introduction

The chart of Geoscience Map Symbols used by Federal, Provincial and Territorial Geoscience Organizations is a compilation of symbols provided by the members of the National Geological Surveys Committee (NGSC). The chart should be considered a "working document" and viewed in the context of it being updated as more symbols are accepted as 'standard'. Comments from all sectors (Industry, University, Government) are welcome. It is suggested that comments from government personnel be submitted through the heads of their organizations to ensure that their suggested symbols represent that organizations view.

Sources of Information

Some organizations (e.g. Newfoundland, Quebec, Geological Survey of Canada) have their own 'Guide to Authors' for the preparation of geoscience maps which were a source of some of the information shown on the chart. More recently, draft 'compilation sheets' based on these guides and other information 'on file' was distributed to members of the NGSC with the request that they update the relevant information in preparation for the publication of a 'first edition' of a chart. The present chart is the result of these responses.

Historical

The chart is a culmination of considerable discussion by members of the NGSC since the committee's inception in 1979. In the May 24, 1979 Minutes of the NGSC, it is noted that one of the draft objectives of the meeting was to "facilitate the establishment of consistent national standards for all types of geoscience surveys". The British Columbia and Quebec members, in correspondence to the Federal co-chairman in February, 1980, suggested that some attention should be given to standardization of legends and symbols. In May 1980, a working group (WG) was established with a representative from the GSC, British Columbia, Quebec, Ontario and Saskatchewan. It was agreed that the basic reference for the WG to start from would be the GSC "Guide to Authors". It was felt by the NGSC that the WG would be able "to propose to the NGSC standard symbols for geological features".

Further discussion at subsequent NGSC meetings of submissions to the WG could not determine agreement as to how, and how much of, the submissions should be displayed in order to obtain comments from the complete geoscience community. It was even suggested that map symbol standardization was not possible. However, the committee agreed that there were a large number of commonly used symbols which could be considered as standard and therefore map symbols should remain an agenda item for further meetings.

In 1988, it was agreed that GSC would provide a draft compilation for review by the NGSC in preparation for distribution of a 'working document' symbols chart. At the March, 1989 meeting, a draft compilation of information "on file" was distributed for comment by the NGSC. In response to several suggestions, the consensus was that a separate chart of symbols in use, which could be readily updated and published at time other than when any specific Journal or other publication was published, and of an approximate 1:250 000 map sheet size (readily wall mounted) would be appropriate. The GSC indicated it would publish the first version. It was also suggested that the chart be called a table of "geoscientific" rather than "geological" map symbols in order to accommodate standard symbols for multiparameter maps, i.e. the map in question may be published as a geological map, but the author(s) may wish to denote boundaries indicated by the interpretation of geophysical data. For example, both Manitoba and Quebec have symbols to indicate geological boundaries located by geophysical surveys.

Present/Future

This first edition, 'working document', of the symbols chart has omitted a number of the symbols submitted by the NGSC members. It is hoped that constructive criticism will be submitted and indicate a preference for which symbols should or should not be 'standard' and additions may be suggested. Perhaps, some of the unique symbols of some organizations would be the preferred standard of all. The objective is to publish as large a data base of 'standard' symbols as is possible for use by geoscientists. If enough standard symbols are agreed upon, it may be necessary to have a two sided quick reference chart.

It is hoped that those receiving the chart in this Journal will circulate it widely (or request additional copies for circulation) amongst their colleagues and request constructive suggestions.

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